

**Using a student response system to provide  
formative feedback in large classes:  
A phenomenographic study  
at the University of Cape Town**

**Ian Stuart Barbour**

BRBIAN001

A minor dissertation submitted in partial fulfilment of the requirements  
for the award of the degree of Master of Philosophy (ICT in Education)

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Supervisor: Associate Professor Cheryl Hodgkinson-Williams

**Declaration**

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# Abstract

The purpose of this study was to gain a better understanding of students' conceptions of the use of a student response system to provide formative feedback in large university classes. The main aim of formative feedback is to increase a student's knowledge, skills, and understanding of specific subject matter, by indicating a gap between the actual knowledge of the student and the required standard. However, in large classes the opportunities for formative assessment are limited, often resulting in little or no immediate feedback given to the students on their learning.

One way of addressing this lack of assessment of students' understanding in the classroom is to incorporate a student response system into the lecture in order to facilitate learning and provide immediate formative feedback. A student response system is a tool that enables students to wirelessly send their responses to questions presented by a lecturer, using a small hand-held remote-controlled device.

Over a seven week period, a TurningPoint student response system was used to support the teaching of Information Systems to a class of first year students at the University of Cape Town. Laurillard's Conversational Framework was used as a theoretical framework to guide the pedagogical practice.

After the teaching period, ten students were purposefully selected, and semi-structured interviews were conducted with the objective of understanding the students' conception of the use of a student response system to provide formative feedback. The interviews were recorded and transcribed, and the empirical data was analysed, using a phenomenographic approach. Phenomenography is an empirically based method that uses semi-structured interviews to identify different ways in which people experience a particular phenomenon. The result of the phenomenographic analysis was a set of categories of description that are hierarchically related, but qualitatively different from each other. These categories, along with the structural themes, formed the output of the data analysis.

The results showed that the students experienced five different categories of feedback, including feedback about the correct answer to each question; about their understanding of the topic; about what the lecturer should do; about the process of learning; and feedback about themselves as a person.

An analysis of the data showed that the students interviewed were assisted in their understanding of the topic by the fact that the student response system provided the correct answers immediately and visually. The anonymity of their responses aided the students to actively participate in class and not be distracted by the criticism of their peers. The students noticed that the clickers provided immediate feedback to the lecturer and this enabled the lecturer to determine the level of understanding of the whole class. The feedback provided by the system also enabled the students to ascertain if they understood the concepts or if they needed additional support.

The results of this study were used to identify the learning activities that are supported by the use of an SRS in the classroom and to develop an interpretation of Laurillard's Conversational Framework for a student response system.

**Keywords:**

Formative feedback, student response system, Laurillard's Conversational Framework, phenomenographic approach

# Plagiarism Declaration

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***Ian Stuart Barbour***

Student Number: BRBIAN001

barbourians@gmail.com

# Acknowledgements

In the acknowledgements section of Stephen Covey's book "The 8th Habit", he talks about his experience of writing and likens it to climbing a mountain.

*After more than a year of teaching the material and writing, my team and I finished an initial rough draft – thrilled we had finally arrived. It was at that moment that we experienced what hikers often discover when climbing mountains: We hadn't reached the summit at all, only the top of the first rise. From this new vantage point of sweat-earned insights we could see things we had never seen before – ones only made visible at the top of that hill. So we set our sights on the 'real' mountain and began the new climb. (Covey, 2004, p. x)*

This research project has felt like that for me – often hoping that what lay ahead was the summit, and each time coming to the realisation that there was another mountain ahead and that all I could do was to enjoy the "sweat-earned insights" and begin the new climb.

But thankfully, as Stephen Covey points out, you cannot climb a mountain on your own and that the "most inspiring mountain climbing achievements in history are not so much stories of individual achievement, but are stories of a unified, talented, prepared team that stays loyally committed to one another and to their shared vision to the end" (Covey, 2004, p. xi).

With this in mind I would like to take this opportunity to thank my "team", those who walked with me and helped me so much along the way:

- To my family for their ongoing encouragement and belief in me.
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# Abbreviations and Acronyms

ADP	Academic Development Program
CLC	Computer Literacy Course
EDU	Education Development Program
ICT	Information Communication Technology
IS	Information Systems
PC	Personal Computer
RF	Radio Frequency
UCT	University of Cape Town
USB	Universal Serial Bus
WAV	Waveform Audio File

## Alternative names for a Student Response System (SRS):

### Clickers

APF	Audience Paced Feedback
ARS	Audience Response System
ART	Audience Response Technology
CCS	Classroom Communication System
CFS	Classroom Feedback System
CPS	Classroom Performance System
CRT	Classroom Response Technology
ERS	Electronic Response System
EVS	Electronic Voting System
GDSS	Group Decision Support System
GRS	Group Response System
IRS	Interactive Response System
LRS	Learner Response System
PRS	Personal Response System
RT	Response Technology
WCFS	Wireless Course Feedback System

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# Chapter 1 – Introduction

## 1.1 Introduction to the Problem

One of the many challenges facing universities today is how to deal with increasing class sizes, while still providing students with ongoing feedback and support. Many instructors struggle to improve student participation, understanding of course concepts, and critical thinking within the context of large classes. Too often, lecturing seems to represent the only practical option to manage large first year university classes (Mollborn & Hoekstra, 2010).

Lecturers have adopted a number of different strategies and technologies to cope better with these challenges, with the aim of encouraging effective learning in the classroom. One such technology is the use of a student response system.

In terms of classroom dynamics, a common goal in using a student response system is to provide an alternative to the traditional impersonal and anonymous large lecture. Trees and Jackson found that although a change in classroom culture can enable students to move from being passive observers to become more involved, “putting clickers in the hand of students, however, does not guarantee an engaged class” (Trees & Jackson, 2007, p. 25). It is therefore important to determine whether technology can assist in meeting the needs of a changing educational environment; hence the purpose of this study is to gain a better understanding of students’ experience of the use of a student response system to provide formative feedback in large classes.

## 1.2 Background of the Study

In 2010 and 2011 I was a full-time staff member working in the Information Systems Department in the Faculty of Commerce at the University of Cape Town (UCT)<sup>1</sup>. My duties included being the lecturer and convener for a first year course called “The Fundamentals of Business Information Systems” (course code INF1002H) which I taught to approximately 75 students who were on the programme of the Commerce Education Development Unit (EDU)<sup>2</sup> at UCT.

The course was taught over a full calendar year, and the students were required to attend two lectures, one tutorial and one practical session each week, and to hand in a number of practical assignments during the year.

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<sup>1</sup> <http://www.uct.ac.za>

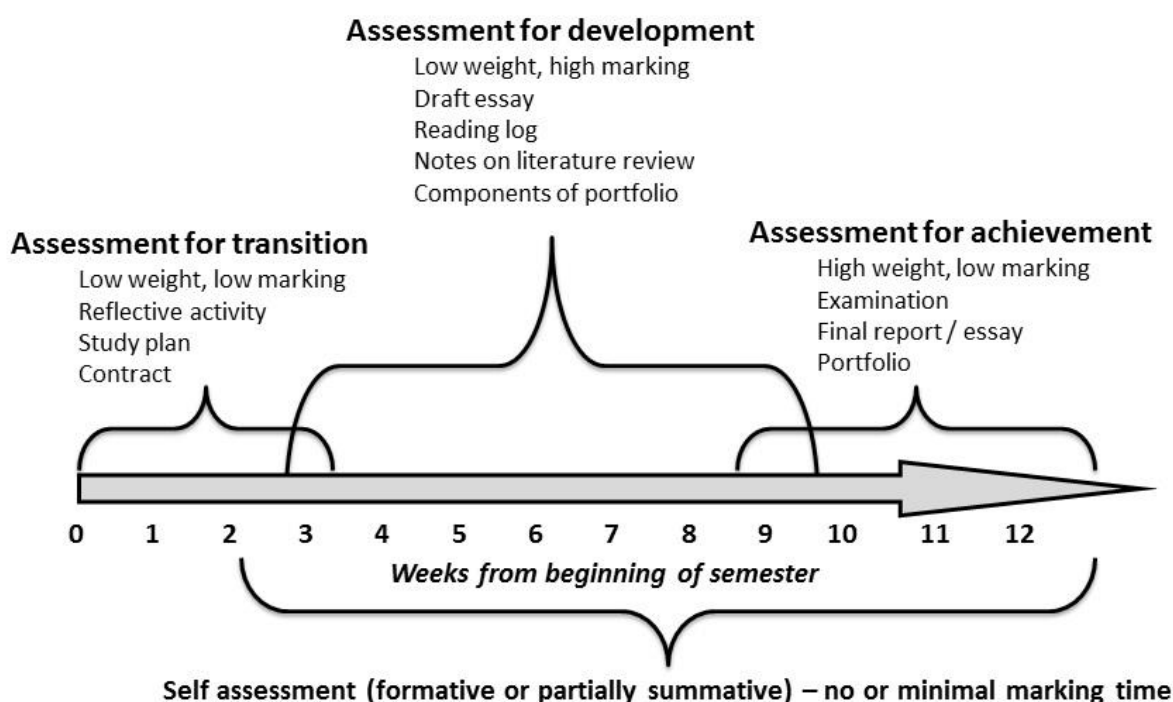
<sup>2</sup> <http://www.educommerce.uct.ac.za>

The instructional goals of the course were:

- To ensure that the students develop content expertise in Information Systems (IS)
- To prepare the students for future learning by providing a foundation for further studies in IS.

### 1.2.1 Course structure

The INF1002H course structure is based on the “model for effective assessment” (Taylor, 2008, p. 21) which proposes that a twelve week semester be divided into three overlapping phases:



*Figure 1.1 – Model of assessment for first year students  
(Taylor, 2008, p. 23)*

The phase **assessment for transition** provides opportunities to engage the students in their studies and to kick-start their activities in the course, with low contribution to final grades.

**Assessment for development** is the heart of the course's assessment scheme and allows for significant feedback and low to middle contributions to the final grade.

**Assessment for achievement** includes final assessments such as essays, portfolios and examinations, with a high contribution to the final grade.

The focus of the first three weeks of the semester is on assessment for transition and involves a skills assessment, activities to assist students in understanding their learning skills, and a

course contract to “awaken the students to the specific needs of the course” (Taylor, 2008, p. 24). This period allows the lecturers and academic support staff to identify students who have poor skills or negative attitudes to learning, and it also allows time for the students to gain an understanding of what is required of them.

Once engagement is established, a six week period of assessment for development follows, which focuses on increasing student engagement and confirming the students’ content expertise. The activities in this period are aimed at developing the skills necessary for later success and have strong links with the later assessment for achievement. This period is characterised by numerous formative assessments providing ongoing feedback and support, with a low contribution towards the final mark. The emphasis is on communicating information to each student, intended to modify their thinking or behaviour, for the purpose of improving learning. The information given to the students in this context is seen as formative feedback, and it is in this phase that this research project is situated.

Towards the end of the semester there is a four week period of assessment for achievement which includes examinations as well as the major essays, final portfolios, reports and projects. These summative assessments make up 60% of the final mark and provide few opportunities for developmental or formative feedback, with students only receiving summative feedback in terms of their final mark.

### **1.2.2 Student Response System**

Throughout the semester a number of different technologies were used in the classroom to support the pedagogical aims; one of them was a student response system (SRS).

A student response system, more commonly known as “clickers”, is a technology that enables students to wirelessly send their responses to questions presented by a lecturer, by making use of a portable remote-controlled device. The technology involves a small hand-held device or wireless transmitter (the clicker) that uses radio frequency, with an alpha-numeric keypad that allows students to respond to questions, which are presented in a multiple-choice format. The questions are displayed on a Microsoft PowerPoint slide, with additional software that works in with MS PowerPoint and allows the question slide to show additional information such as a histogram of the class responses (Mula & Kavanagh, 2009).

Research has shown that using a student response system in the classroom encourages active learning (Judson & Sawada, 2002); allows instructors to get precise real-time feedback (Lasry,

2008); is good at anonymous data collection (Poirier & Feldman, 2007); and encourages active student participation in large lecture classes (Mayer, Stull, Deleeuw, & Almeroth, 2009).

The ability of the SRS to allow the lecturer to ask a question which requires a response from the students and then gives immediate feedback on the individual responses, appears to be an effective means of providing formative feedback to a large class of students; it was used extensively in this way to administer formative assessments during the INF1002H lectures.

### **1.3 Rationale and Objective**

The period of ‘assessment for development’ focuses on delivering numerous formative assessments with a strong emphasis on formative feedback over a sustained period of time. The pedagogical premise underlying this phase is that “good feedback can significantly improve learning processes and outcomes – if delivered correctly” (Shute, 2008, p. 154).

This situation – the importance of formative feedback and the reliance of the SRS to deliver the feedback – has given rise to the need for empirical research in order to determine if an SRS is an effective mechanism for providing formative feedback in large classes.

The need is for focused research to be undertaken in this area in order to provide a valid theoretical argument for the adoption or rejection of the technology, rather than to just rely on the anecdotal evidence that currently motivates the use of a student response system in the INF1002H classroom.

The objective of this research is to study the phenomenon of using a student response system to provide formative feedback, in order to determine the students’ conception of the effectiveness of using an SRS to provide feedback in this manner. Understanding the students’ conception of the phenomenon will help the convenors of the course to better understand the benefits and/or limitations of the use of an SRS as a pedagogical tool in the classroom.

Although previous research has shown that good feedback can improve learning (Shute, 2008), it is quite possible that the use of an SRS is seen by the students as a hindrance to the learning process. On the other hand, students could also see an SRS as a positive influence and an effective mechanism, or they could be neutral with respect to the impact of its use on their learning processes. The objective of this research is therefore to provide empirical evidence that can be used to provide clarity on this discussion.

## 1.4 Research Question and Purpose

This study takes a phenomenographical approach in order to gain an understanding of the students' experience of the use of an SRS to provide formative feedback in large classes. The research question is:

*What are the students' conceptions of the use of a student response system to provide formative feedback in a large class?*

The question was selected in order to gain a better understanding of the variation of the students' experience of the benefits and limitations of the use of an SRS to provide formative feedback in large classes, as well as to guide future implementation of SRS technology at the university.

## 1.5 Nature of the Study

The study used the Conversational Framework (Laurillard, 2002) to guide the pedagogical use of the student response system in the classroom, while the data was analysed using a phenomenographic approach.

Phenomenography is "an empirically based approach that aims to identify qualitatively different ways in which different people experience, conceptualise, perceive, and understand various kinds of phenomena" (Marton, 1988, p. 53). The phenomenographic method uses semi-structured interviews with the participants in order for the researcher to understand their experience of the phenomenon, in this case the use of a student response system to provide formative feedback. The focus is on describing and understanding the range of experiences of the whole group rather than on describing and understanding individual experiences. The outcome of phenomenographic approach is a set of categories of description and structural themes, represented hierarchically to form an outcome space.

Ten students from the INF1002H class were purposefully selected, and semi-structured interviews were conducted, with the objective of understanding the students' conception of the use of a student response system to provide formative feedback in the classroom. Each interview was recorded and transcribed verbatim, and the interview transcripts became the empirical data for the qualitative data analysis phase.

The transcripts were analysed by combining all relevant elements from all the interviews. All quotations from all the transcribed interviews were identified and extracted in order to create a single list of distinct quotations. Similar quotations were grouped and coded, and preliminary



groups were created. This was an iterative process that continued until all quotations were grouped and named. As the categories emerged from the data, these were identified and described. Part of this process was the discovery of structural themes that described the similarities and differences between the categories.

The outcome of this process was a set of five categories of description and three structural themes that constituted the phenomenographic outcome space.

## **1.6 Organisation of the Document**

This mini-dissertation is organised into six chapters:

### ***Chapter 1 – Introduction***

This chapter provides an overview of the study as well as the background information to the research problem. The chapter describes the rationale for the study, introduces the research objectives and question, and explains the theoretical framework and research methodology that are used in the study. The chapter ends with a brief outline of each chapter.

### ***Chapter 2 – Literature Review***

Chapter 2 presents a summary of the review of literature focusing on formative feedback and on student response systems in large classes, and it describes the different pedagogies used by other researchers in similar environments. The chapter introduces Laurillard's Conversational Framework and explains how the framework is used in this study to define the key concepts of a student response system (SRS), and how the framework is applied in order to provide a theoretical basis for the use of the SRS in the classroom.

### ***Chapter 3 – Research Methodology***

The third chapter introduces the research methodology and explains the reasoning for using a phenomenographic approach to gather and analyse the data. This chapter describes the data collection process and documents how the students were selected to be interviewed, and how the interviews were structured, recorded and transcribed. The chapter explains how the transcriptions were analysed using a phenomenographic approach and shows the steps that were taken in order to produce the final phenomenographic outcome space.

### ***Chapter 4 – Findings***

Chapter 4 presents the findings of the study by first describing the categories of the outcome space and then by showing how the hierarchy of categories describes the students' conception

of the use of a student response system to provide formative feedback in large classes. The chapter presents the three structural themes and concludes with a discussion of the findings.

### ***Chapter 5 – Discussion***

This chapter relates the findings presented in Chapter 4 to Laurillard's Conversational Framework discussed in Chapter 2. The findings are used to show the learning activities that are supported by a student response system and this information is then used to develop a diagrammatic representation of the interpretation of Laurillard's Conversational Framework for an SRS.

### ***Chapter 6 – Summary and Recommendations***

The final chapter summarises the main findings, provides a conclusion, and shows how the research is useful to the institution. The chapter ends with suggestions for future research and concluding remarks regarding the overall study.

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## **Chapter 2 – Literature Review**

### **2.1 Introduction**

The period of assessment for development described in the previous chapter focuses on the lecturer maintaining engagement with the students by delivering numerous formative assessments, with a strong emphasis on providing ongoing feedback and support. The pedagogical premise underlying this phase is that “good feedback can significantly improve learning processes and outcomes – if delivered correctly” (Shute, 2008, p. 154). This study investigates the use of a student response system (SRS) to provide feedback, by using multiple-choice assessments to evaluate the students’ knowledge of the topics presented to them in the classroom, and by providing immediate feedback on their actions in order to support their learning goals.

The purpose of this literature review is to understand the conceptual relationship between assessment, formative assessment, and formative feedback, and to investigate how a student response system can be used to provide ongoing feedback and support to students in large classes. The review then investigates the pedagogical aspects of using a student response system and concludes with a discussion of how Laurillard’s Conversational Framework can be used to provide a theoretical framework to guide the pedagogical use of an SRS in the classroom.

### **2.2 Formative Assessment and Feedback**

#### **2.2.1 Assessment**

The importance of assessment as part of the student learning experience is well accepted in the literature (Allin & Fishwick, 2009; Black & Wiliam, 1998; Taras, 2005). Students see value in continuous assessment, and the assessment requirements are often seen as the most important part of a course curriculum (Kift & Moody, 2009). However, although assessment plays such a central role in education, the literature provides no single definition or generally accepted description of the term. Depending on the context of their own experiences and traditions, authors offer different definitions. Black and Wiliam regard assessment as a more general term that includes “all activities undertaken by students and teachers that provide information to be used as feedback to modify teaching and learning” (1998, p. 2). Taras (2005), on the other hand, argues that assessment should be seen more narrowly as a judgement that is justified

according to specific criteria, with the outcome being either a comparative or a numerical weighting.

The general definition of assessment is more relevant to this study and can be further be clarified by taking into account the role of feedback in the assessment process.

### **2.2.2 Feedback**

In the context of education, feedback is commonly used to refer to information provided by “an agent” to students about their work (Hattie & Timperley, 2007, p. 81). This agent could be a teacher, fellow students, the students themselves, an experience, or technology such as a student response system. The main purpose of feedback in the classroom is to provide information to learners about their current work, by providing an evaluative response with the objective of influencing the quality of work to be done in the future (Berge & Collins, 2005; Boud & Molloy, 2012).

Including the role of feedback in the definition of assessment allows for assessment to be defined as either summative or formative. Generally, providing summative assessment means that the feedback given cannot change the outcome of the assessment; by contrast, with formative assessment the feedback provided can influence the output and allows for reassessment (Hattie & Timperley, 2007).

### **2.2.3 Summative assessment**

The feedback generated by summative assessment is important as it informs students of how their final performance has met the learning outcomes. Summative assessment is mainly concerned with the extent to which a student has achieved curricular objectives and is generally regarded as a final verdict (Yorke, 2003). Wininger (as cited by Reamer, 2009) notes that summative assessment is more often used at the end of a semester or module, with the purpose of grading in order to provide a certification or a final evaluation of the student’s progress.

### **2.2.4 Formative assessment**

An assessment can be defined as formative if the feedback provided can be used to influence the output and allow for reassessment. Feedback is therefore a key part of formative assessment. The central purpose is to enable student learning through the provision of information in order to create opportunities to improve learning and performance (Harlen, 2003; Lilley & Barker, 2007). The role of feedback is to identify the gap between what the student currently knows and the required standard, and to give an indication to both teacher and student as to how the work can be improved (Taras, 2005). In this way, feedback creates a

dialogue between the teacher and student and provides an opportunity for the student to engage the teacher in a discussion about the assessment (Yorke, 2003).

Feedback provided during the process of formative assessment is referred to as formative feedback.

### **2.2.5 Formative feedback**

Formative feedback includes any kind of communication to the students that promotes learning. It may include advice intended to improve students' learning skills, or it may be designed to encourage reflection or critical thinking (Søndergaard & Thomas, 2004). The main objective though is to assist the students to adjust their progress towards the learning outcomes, and to increase their knowledge and understanding in some content area or general skill (Berge & Collins, 2005; Shute, 2008). In the literature on formative feedback it is noted that "relevant, consistent, and integrated assessment with prompt and constructive feedback" (Scott, 2005, p. 12) is particularly relevant to "assisting students make the successful transition to assessment in higher education" (Kift & Moody, 2009, p. 3).

For the purposes of this study, *formative feedback is defined as information communicated to each student, which is intended to modify their thinking or behaviour, for the purpose of improving learning.*

## **2.3 Research on Large Classes**

Due to increasing student numbers and limited resources, large classes have for many years been the norm for many first year university students (Freeman & Blayney, 2004). Unfortunately large classes are usually associated with less than favourable outcomes, including increased reliance of the traditional lecture, difficulty in interacting with the students, and few opportunities for the students to discuss or apply what they are learning (Gebru, Phelps, & Wulfsberg, 2012; Laurillard, 2002; Laxman, 2011; Mollborn & Hoekstra, 2010).

One of the challenges relevant to this study is to find ways of creating opportunities for formative assessment and feedback within large classes.

### **2.3.1 Teaching large classes**

Many students find it hard to speak up in a large class of peers and call attention to what they do not know. Some students, particularly those at the back of the class, may not be engaged at all with the presentation (Duncan, 2006). Students find it easy to get 'lost in the crowd' and feel stifled by the lack of active engagement. When engagement is encouraged, "it often leads

to more intimidation, permits others to hide, come unprepared, or with little excuse, to just not come at all” (Hancock, 2010, p. 226).

### **2.3.2 Large classes and formative feedback**

Bigger class sizes mean that the opportunities for providing formative assessment are limited, often resulting in little or no formative feedback given to the students. Larger classes and limited resources often result in the lecturer doing most of the talking, rather than trying to create opportunities for formative assessment and feedback (Lilley & Barker, 2007).

In a regular classroom, feedback can be given by multiple means, including asking students to raise their hands, asking for volunteers to share their answers, the use of small boards to display answers, or even by handing out coloured cards to represent multiple choice responses (Berge & Collins, 2005; Kay & LeSage, 2009a). But while these are all effective options, each presents a logistical challenge when used in large classes.

Consequently, lecturers adopt a range of strategies and technologies to better cope with these challenges, and one of these is the use of a student response system.

## **2.4 Student Response Systems**

A student response system (SRS), more commonly known as “clickers”, but also known as an audience response system (ARS), a personal response system (PRS), or a classroom response system (CRS), is a technology that enables students to wirelessly send their responses to questions presented by a lecturer, using a small hand-held remote-controlled device.

The technology involves a hand-held device (the “clicker”) or wireless transmitter that uses radio frequency or infrared technology, with an alpha-numeric keypad that allows students to respond to questions which are usually in a multiple-choice format. The question is typically displayed as a PowerPoint slide that can be embedded in a normal slide set, with additional software that works in consort with Microsoft PowerPoint and allows the design of the question slide to include feedback information such as graphical representation of responses (Mula & Kavanagh, 2009).



3

*Figure 2.1 – Turning Technologies radio frequency clicker and receiver*

#### **2.4.1 History of “clickers”**

Clickers are not a new phenomenon but have been around in some form or another for more than 20 years. Initially they were used as analogue cable based systems, whereas the current response systems use wireless keypads with USB-based receivers which integrate seamlessly with presentation software.

Some alternate older delivery methods included using hard-wired telephone keypads (Shapiro, 1997), Palm PDA's (Penuel, Yarnall, & Roschelle, 2004), wireless Bluetooth devices (Menon, Moffett, Enriquez, Martinez, & Dev, 2004), laptop computers (Pargas, 2005) and browser-based devices (Deal, 2007).

Before educators started to discover clickers they had been used primarily by businesses for focus groups, employee training, and meetings (Collins, 2007). Since the early 1990s, a number of different student response systems have gradually made their way into college classrooms in the United States of America, and reliable, easy-to-use systems have been available since 1999 and are now used in many different countries around the world (Beatty, 2004).

Clickers are used in a wide variety of disciplines, including psychology, mathematics, biology, chemistry, economics, statistics and many others. They have also been used in a variety of courses within these disciplines, from large introductory courses to smaller discussion courses, tutorials and laboratory classes, and at all levels of education from primary school to university (Lantz, 2010).

<sup>3</sup> <http://www.turningtechnologies.com/audienceproducts/responseoptions/responsecards/responsecardrf>

### **2.4.2 Using a student response system in the classroom**

Most pedagogical models using a student response system encourage students to discuss clicker questions cooperatively, in pairs or small groups, before “clicking in” with their individual answers (Duncan, 2006; Mazur & Watkins, 2007; Mollborn & Hoekstra, 2010). Once student votes are tabulated by means of the SRS software, the entire class’ responses to a clicker question can be publicly displayed graphically in aggregate form, enabling the whole group to see the outcome of all responses (Hoekstra, 2009).

A number of books (Duncan, 2004; Landis, Ellis, Lisensky, Lorenz, & Meeker, 2001; Mazur, 1997) have been written for teachers on the use of student response systems and the associated pedagogical methods that accompany them, and suitable multiple-choice questions for various fields are made available to instructors by textbook publishers (MacArthur & Jones, 2008).

Research has shown that using an SRS in the classroom encourages active learning (Judson & Sawada, 2002); allows instructors to get precise real-time feedback (Lasry, 2008); are good at anonymous data collection (Poirier & Feldman, 2007); and encourages active student participation in large lecture classes (Mayer et al., 2009). They can also be used for measuring what students know; measuring students’ attitudes; finding out if students have done the readings; testing students’ understanding of coursework; and making assessments easier and more accessible to students (Immerwahr, 2009).

## **2.5 SRS in Large Classes: Benefits and Challenges**

Using a student response system in large classes has a number of benefits as well as a number of challenges. The benefits include creating a classroom environment conducive to learning, as well as being used for assessment purposes. Challenges are teacher-centred and student-centred challenges.

### **2.5.1 Benefits for the classroom**

A student response system enables students to be more focussed in class. The use of an SRS allows the lecturer to divide the lecture into different parts, and a number of studies that have noted that this helps students to pay attention, resulting in an increased sense of focus in the class. Students have a limited attention span and periodic breaks during a lecture help students overcome fatigue and can “restart the attention clock” (Caldwell, 2007, p. 12). Asking questions during the lecture can change the pace of instruction allowing for the class to refocus and to shift their attention to the new activity (Draper & Brown, 2004).



There are a number of studies that show that students appreciate being able to remain anonymous while using a student response system. The benefits are that the students can stay active members of the classroom, while still being able to participate without having to worry about those around them (Kay & LeSage, 2009b). Clickers make it possible for the students to interact with the material in a way that allows for their responses to be seen by all, but for their identity to remain anonymous (Sanseverino, 2010). Allowing students to remain anonymous increases participation and encourages active engagement in class and this is beneficial to the students and to the lecturer (Draper & Brown, 2004).

It is important for students to participate with their peers in solving problems in class. Using a student response system allows for a pedagogy like Peer Instruction (Mazur, 1997) to be implemented as the SRS provides an easy way to ask questions and to collect the answers. Students can be encouraged to discuss their answers and share their ideas with one another and in doing so increase the level of participation in the classroom. This changes a relatively static one-way transmission of information into a dynamic, interactive lecture guided by student input (Cutts & Kennedy, 2005). An SRS can also provide the students with instantaneous feedback which keeps them more engaged and helps in creating an active environment in the classroom (Collins, 2007).

### **2.5.2 Benefits for learning**

In order to address the issues of attention and engagement in large lecture classes, many colleges and universities have turned to a student response system to facilitate student interaction (Johnson & Meckelborg, 2009). Using clickers changes the role of the student from a passive observer to be more engaged and participative, and this provides an alternative to the impersonal and anonymous traditional large lecture (Trees & Jackson, 2007).

Requiring the students to participate by answering questions in class allows for the lecturer to receive immediate feedback about the students' understanding of the topics being presented. This type of feedback can then be used by the lecturer to modify explanations or the mode of instruction according to the immediate needs of the students (Caldwell, 2007). The result is that the structure of the lecture becomes dependent upon the actions of the students, rather than following a pre-determined sequence (Draper & Brown, 2004). For this reason, feedback about what the lecturer should do is seen as one of the major benefits of using an SRS in the classroom.

### **2.5.3 Benefits for assessment**

A student response system can be used as a formative assessment tool in order to help identify areas where students are struggling (King & Robinson, 2009a), as well as a summative assessment tool for the purposes of determining a student's final grade in a course (Hancock, 2010). The benefit of using an SRS for formative assessment is that the system is able to provide immediate feedback to students enabling them to judge how well they understanding the material without a mark being included in the assessment. When used for as a summative assessment tool, the clickers are linked to individual students and the answers are then gathered at the end of a lecture as a graded assessment item. Bruff (2009) recommends using this approach to measure prior knowledge before the semester begins, as well as to gauge how well a concept was understood prior to advancing to other content. However, the technology is not seen as being robust enough to be used in high-stakes summative testing and should rather be used for informal evaluation of student understanding (Bruff, 2009; Moreau, 2009; Sanseverino, 2010).

### **2.5.4 Teacher-based challenges**

There are a number of teacher-based challenges when using a student response system. One benefit is for the lecturer to collect feedback as the lesson progresses, although research shows that it is not always that easy to adjust the teaching and offer a different explanation when students do not understand (Kay & LeSage, 2009b). Inexperienced teachers may find this difficult to do, leading to the students becoming frustrated and confused, and following a strategy like peer instruction may help overcome this problem (Hu, Bertol, Hamilton, White, & Duff, 2006).

Another concern is that writing good multiple choice questions takes time and can be a demanding task for instructors (Caldwell, 2007). Although there are a number of collections of SRS questions available, instructors may have to develop their own original questions. This is a challenging undertaking and one that needs to be overcome before the system can be used effectively in the classroom (Beatty & Gerace, 2009; Cutts & Kennedy, 2005).

### **2.5.5 Student-based challenges**

Some students may respond negatively to the use of an SRS simply because it is a new way of teaching and is different to what they are used to. Students may react with confusion and distrust, and may question their ability to direct their own learning using an SRS. But if these feelings are acknowledged then the initial resistance can be easily overcome (Beatty, Gerace, Leonard, & Dufresne, 2006; Kay & LeSage, 2009b).

## **2.6 Response System Pedagogy**

In order to overcome the challenges and to realise the benefits of using an SRS, it is important to ensure that the implementation and use of the technology follows a pedagogical approach. This starts with creating a learning environment in the classroom and then seeing how the technology can be used correctly in order to support the environment.

### **2.6.1 Creating a learning environment**

To create a productive learning environment in the classroom, teachers need information about student learning. This information allows the teacher to become aware if the students' understand the concepts being presented, and also enables the teacher to intervene effectively if the environment they have created is not producing the desired results (Boud & Molloy, 2012). Students do not learn much while sitting passively just listening, but rather they need to "talk about what they are learning, they need to write reflectively about it, relate it to their past experiences, and apply it to their daily lives" (Chickering & Ehrmann, 1996, p. 3). A student response system is able to create an active learning environment in the classroom by engaging the student in active participation through tests and quizzes and in doing so is able to provide feedback to teacher and student about student learning.

### **2.6.2 Pedagogical approach when using a student response system**

In a study by Laxman it was found that improved student performance was partly due to the "pedagogical affordance of clickers in offering formative assessment" (2011, p. 92). Heinrich, Milne and Moore noted that it is essential to use technology for the right pedagogical reasons, "as the use of technology for its own sake will not improve educational assessment" (2009, p. 179).

It is possible for the use of a student response system to transform the pedagogy of a large classroom, as the clicker is able to provide each student with an opportunity to engage with the lecturer and with the content presented. Each student can then individually respond to questions asked and get immediate feedback. This also gives the lecturer a chance to assess the understanding of the whole class (Trees & Jackson, 2007).

But the clicker itself does not transform the classroom, or ensure engaged, active students. Rather, it is only a tool that can facilitate the process depending on how it is used and "in part upon the expectations that students bring to the large lecture class" (Trees & Jackson, 2007, p. 35). The use of clickers in the classroom needs to be guided by a sound pedagogical framework.

### **2.6.3 Pedagogical frameworks to guide the use of a student response system**

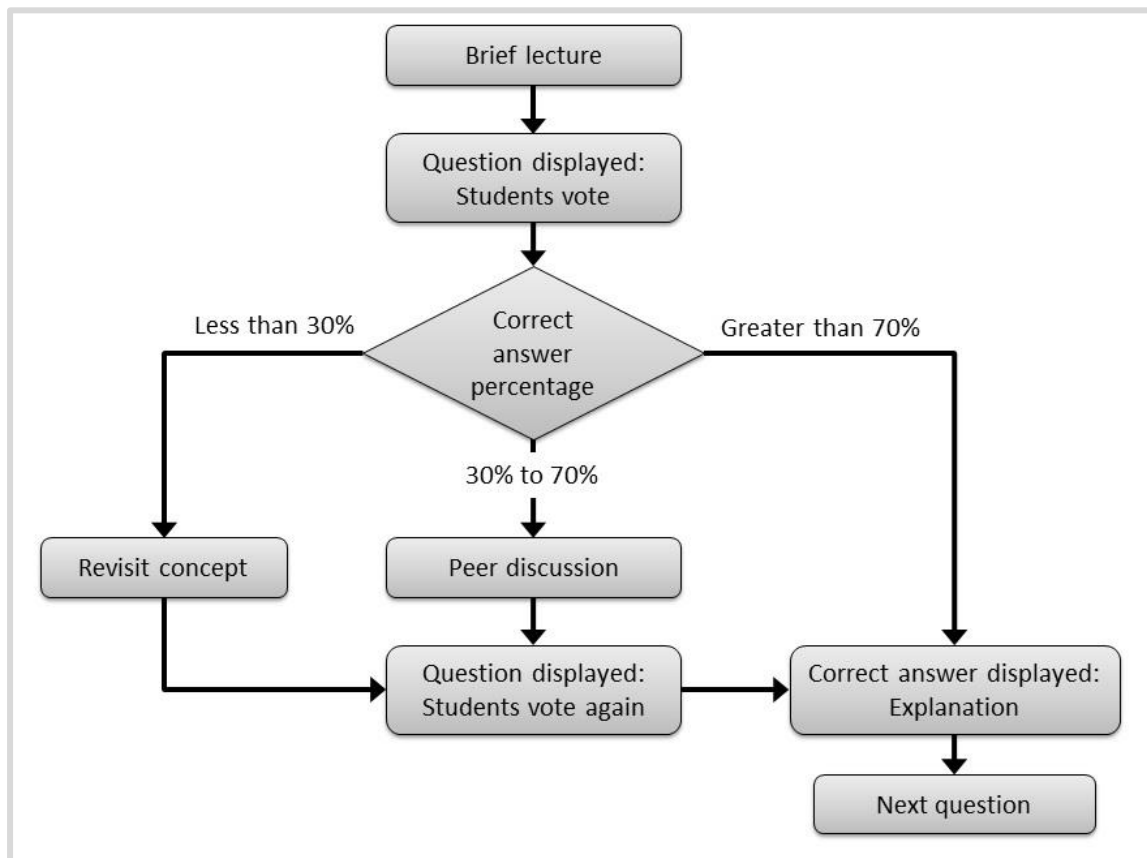
A student response system has the capacity to enhance or increase student engagement during lectures, but in order to be effective “it must be used together with and associated pedagogic application” (King & Robinson, 2009b, p. 25). There are a number of pedagogical frameworks that have been used to guide the use of a student response system. Three of the more widely used frameworks are: Peer Instruction (Mazur, 1997); Technology-Enhanced Formative Assessment (Beatty, 2007); and Laurillard’s Conversational Framework (Laurillard, 2002).

The Peer Instruction method of teaching involves lectures interspersed with questions that are designed to help students with their understanding of the material presented (Mazur, 1997). After a brief lecture, students are given one or two minutes to work on a challenging question on their own, and are then required to provide an answer ideally through the use of a student response system. A histogram of responses is then displayed, showing the percentage distribution of how the class has answered the question. The students are then asked to discuss the answer in groups of three or four, attempting within the small group to reach consensus on the correct answer (Crouch & Mazur, 2001). This process forces the students to develop an argument that supports their understanding while they are still in the classroom.

The flow chart in Figure 2.2 shows how the progression of the class can be adapted in real-time in response to the feedback received from the students about their understanding of the topic (Lasry, 2008).

- If less than 30% of the class answer correctly then the teacher should revisit the topic.
- If between 30% and 70% of the students answer correctly then the students are asked to discuss the problem with their peers and to try and reach consensus about the answer.
- If more than 70% get the answer correct then the teacher provides a brief explanation and moves on to the next question.

The use of an SRS is not a requirement for this process, but the technology is able to greatly reduce the time spent collecting the answers and this increases the effectiveness of the process.

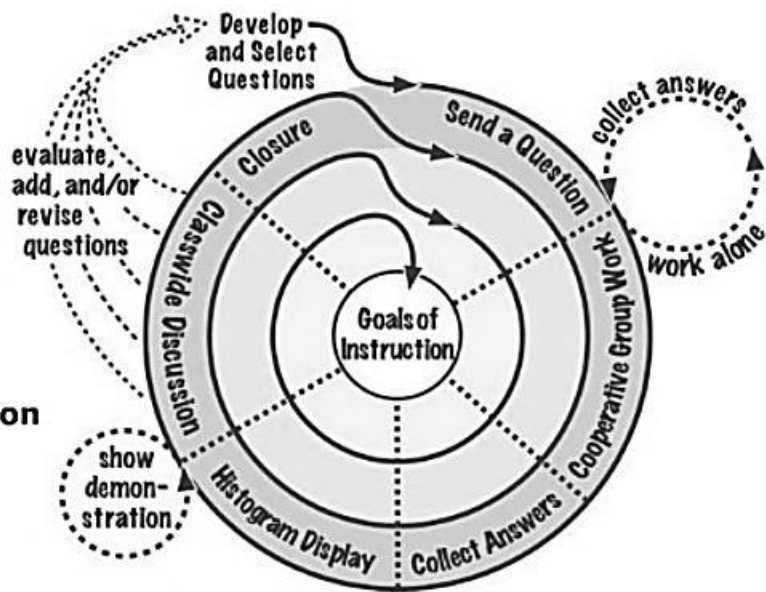


**Figure 2.2 – The ConcepTest Peer Instruction implementation process**  
*(Adapted from Lasry, 2008, p. 242)*

Technology-Enhanced Formative Assessment (TEFA) is centred on an iterative question cycle that is facilitated by the use of a student response system. A teacher poses a question in class and the students are then required to grapple with the answer before discussing the problem in small groups. The students' replies and suggestions, the justification of their answers, and the merits of the proposed solutions are shared with the group before the teacher provides closure by summarising the responses and showing the correct answer. TEFA identifies four core principles of instruction, which are referred to as "question-driven instruction, dialogical discourse, formative assessment, and meta-level communication" (Beatty & Gerace, 2009, p. 159). The framework provides the teacher with a pedagogy that supports these principles and shows how technology, like an SRS, is able to support the learning objectives.

## Typical Question Cycle (7 stages)

- Choose Item
- Present Item
- Group Work
- Collect Answers
- Display Histogram
- Classwide Discussion
- Closure



*Figure 2.3 – TEFA Technology-Enhanced Formative Assessment  
(Beatty, 2007, p. 2)*

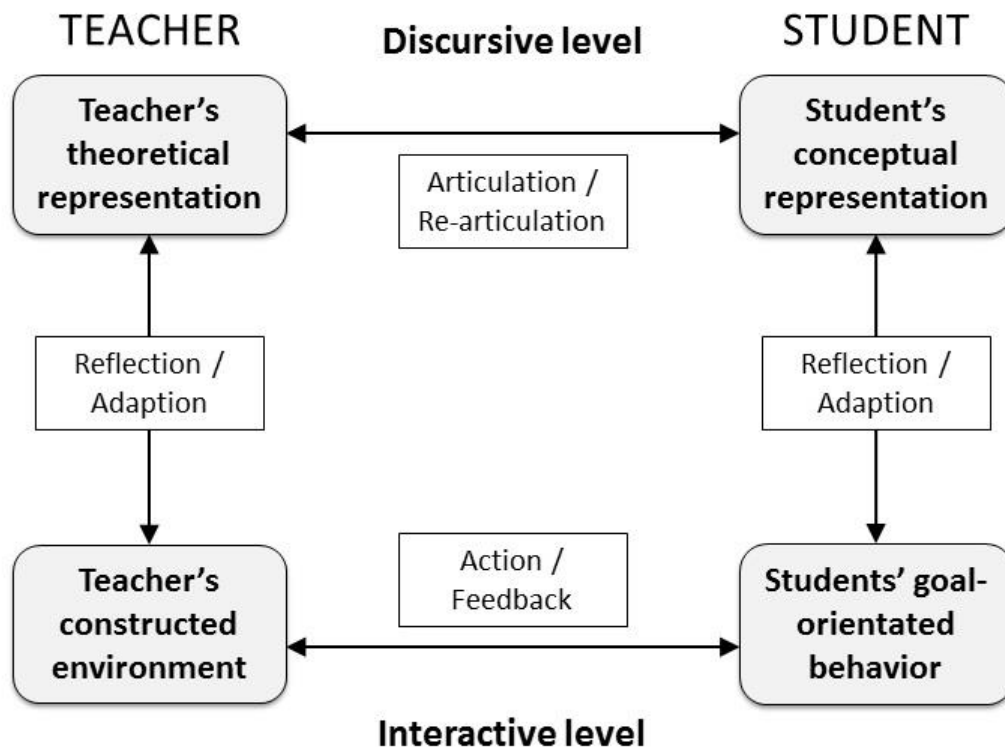
Laurillard’s Conversational Framework is another framework that can be used to guide the pedagogy for the use of an SRS, and this framework is discussed in more detail in the next section.

## 2.7 Laurillard’s Conversational Framework

### 2.7.1 Overview of the Conversational Framework

Laurillard states that an effective teaching strategy needs to be based on an epistemology that “situates learning as a relationship between the learner and the world, mediated by the teacher” (2002, p. 86). Broadly, this process can be described as a ‘conversation’ between teacher and student which operates on two levels, discursive and interactive, with the two levels connected through the processes of reflection and adaption (Laurillard, 1998).

This can be diagrammatically represented as follows:



*Figure 2.4 – Conversational Framework for the learning process  
(Laurillard, 1998, p. 4)*

Students' engagement with an interactive resource, like a clicker, takes place at the interactive level, while the adaption and reflection on their actions takes place at the discursive or theoretical level. The teacher is able to mediate this process through the teacher's constructed environment. By reflecting on the students' goal orientated behaviour, the teacher can adapt the constructed environment in order to provide feedback to the students on their actions. This cyclical process creates a dialogue between teacher and student.

### **2.7.2 Interactive level**

A student response system is designed to increase student engagement and activity and therefore can be seen to operate at an interactive level. By presenting a number of multiple choice questions, the teacher can set a task goal that requires an action from the students. Feedback is then provided by the SRS in the form of the histogram of responses showing how the whole class has answered. By delaying the feedback on the correct answer, the teacher can provide an opportunity for the students to reflect on the concept and then the student can adapt their action in light of the theory, goal and feedback. After answering the question again, the SRS can then provide additional feedback in the form of the correct answer to the question. This process can become a continual iteration achieved by presenting a number of different questions about the topic.

### **2.7.3 Discursive level**

This is the level at which the teacher articulates their conception to the students by presenting a brief lecture, supported by traditional media like PowerPoint, videos and projection software (Laurillard, 2009). Students can respond by asking questions and by presenting their conceptual ideas to the teacher. The teacher can then re-describe the students' conception, based on the type of questions asked as well as on the conceptions presented.

One of the activities at this level is the students' description of their conception, provided as an output to the teacher. Most student response system software is able to provide different reports showing how the students answered each question, and this information is normally available after the session has been concluded. In this way, students in large classes are able to provide to the teacher their theoretical understanding of the concepts presented.

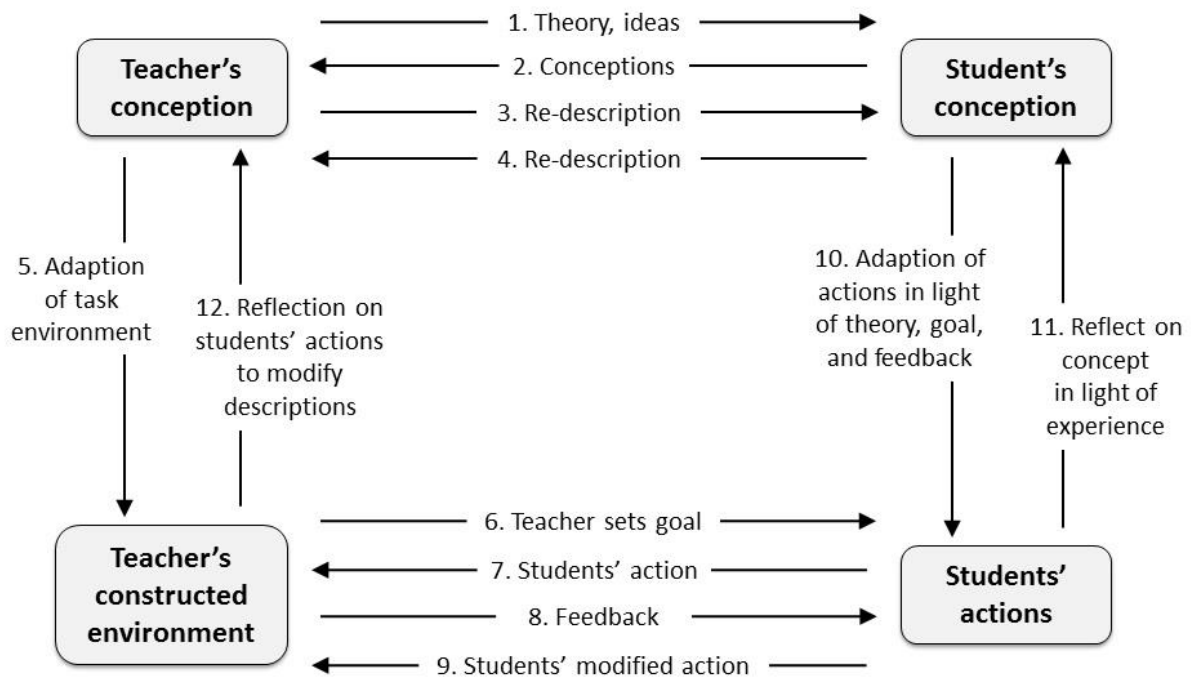
### **2.7.4 Learning activities for the Conversational Framework**

In order for this mediated dialogue to occur, there are a number of requirements within the 'conversational framework' that need to be in place. They are (Laurillard, 2002):

- The dialogue must be an iterative process.
- The process must be discursive, adaptive, interactive and reflective.
- The process must operate at the level of description of the topic.
- The process must operate at a level of actions within related tasks.

For learning to take place, it is important that each of the four requirements occur in one form or another, and for the core structure of the Conversational Framework to remain intact (Laurillard, 1999). The figure below shows a diagrammatic representation of these requirements, and identifies the activities needed in order to complete the learning process:





**Figure 2.5 – Conversational Framework learning activities**  
(Laurillard, 2002, p. 86)

The arrows denote the activities that take place between the teacher and the student, and these activities also represent the iterative dialogue between the participants. The discursive process is represented by activities 1 to 4; the adaptive process as activities 5 and 10; the interactive process as the series of activities 6 to 9; and the internal reflective process represented by 11 and 12 (Laurillard, 2002).

An interactive technology like a student response system allows for a continual iteration of setting a goal, requiring the students' action, and providing feedback on that action; these actions are shown in Figure 2.5 as activities 6, 7, 8 and 9. An implicit aspect of the Conversational Framework is that it caters for this succession of iterative cycles and also accommodates a time-based linear sequence.

### **2.7.5 Constructing a narrative line**

The Conversational Framework can also be presented as a linear sequence of activities that includes the four requirements and maintains the core structure of the framework. Laurillard referred to this as the “narrative line” (1998, p. 5). Teachers must be clear about what activities it takes to understand a topic, and be clear to create the affordances for these activities (Laurillard, 1998). Making the narrative line explicit is a way of achieving this objective.

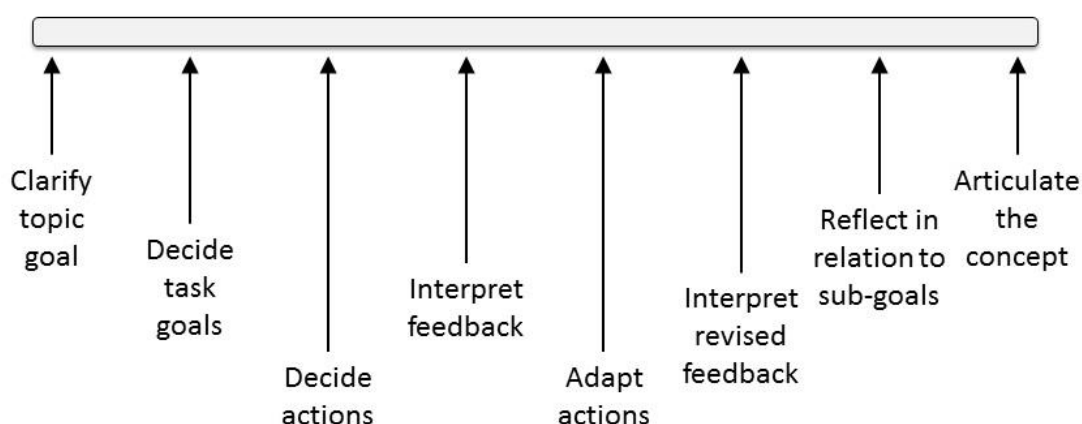
Presenting the Conversational Framework in this form also allows for interactive technologies to be mapped against the core requirements, thus making it possible to determine the extent to which each technology can support the activities required for students to learn.

A linear sequence of the Conversational Framework activities can be shown as follows:

1. Teacher presents theory and ideas
2. Student expresses understanding through comments or questions
3. Teacher re-describes the conception based on the understanding
4. Student re-describes their conception of the topic as output
5. Teacher adapts constructed environment
6. Teacher sets task goal
7. Student acts to undertake task
8. Student receives feedback on action
9. Student generates new action to undertake task
10. Student adapts action in the light of conceptual knowledge and feedback
11. Student reflects on interaction using conceptual knowledge
12. Teacher reflects on student interaction to begin new dialogue.

This optimal “sequence of iterations of dialogue, action-feedback, adaptation and reflection allows the students to be exposed to new ideas, to link these to enhancing their practice, to improve their practice and link this improved practice to further developed understanding, and to assure the quality of their understanding” (Laurillard, 1998, p. 5).

Unravelling the iterative cycles as a timeline shows the activities the students need to perform as they work through the process. The timeline can be presented diagrammatically as follows:



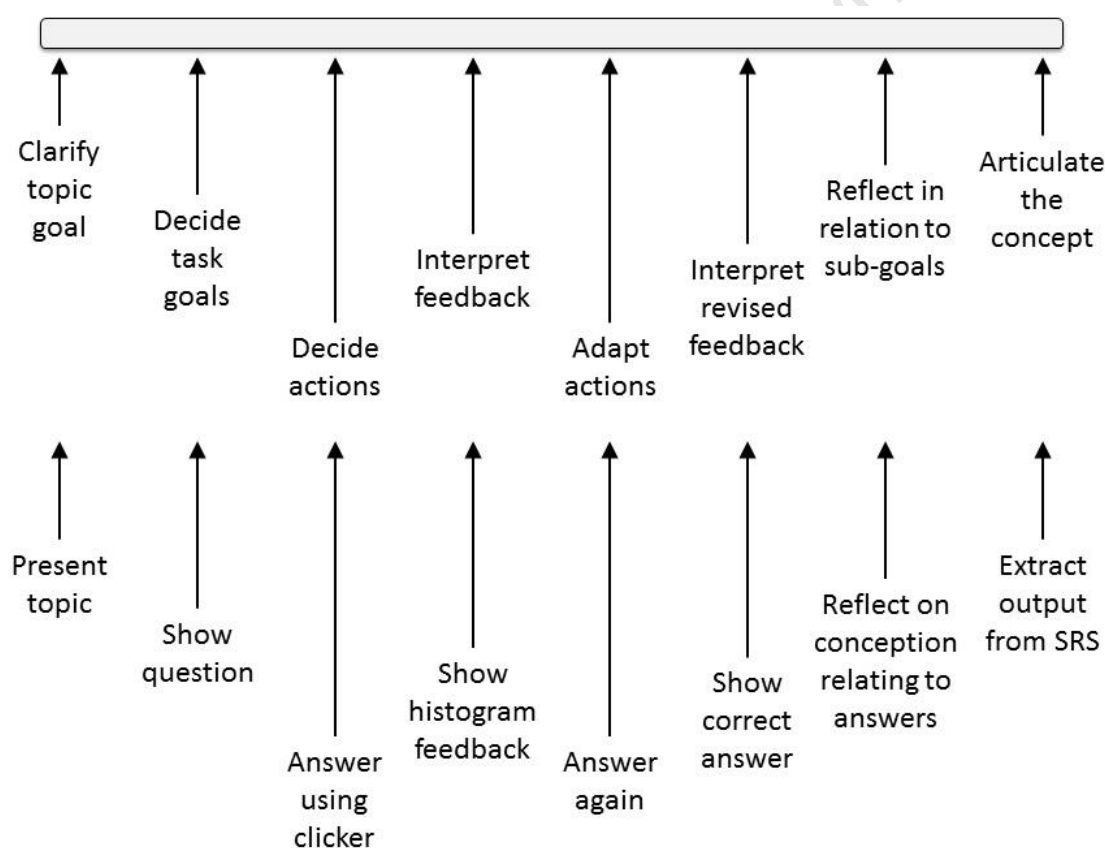
**Figure 2.6 – Representation of the Conversational Framework narrative line**  
(Laurillard, 1998, p. 9)

This simplified linear version of the narrative line shows the activities needed to help the students move towards the goal of being able to describe their understanding of the topic. Each activity helps to drive the process forward, from having to clarify the topic goal, identifying the actions needed, interpreting the feedback and then reflecting on the outcome in relation to the task goal.

### 2.7.6 A narrative line for a student response system

From the narrative line shown in Figure 2.6 it is possible to deduce the kinds of activities needed when using a student response system in the classroom, such as described in the following paragraphs.

These activities are presented by Figure 2.7 in graphical format:



**Figure 2.7 – Representation of the narrative line for a student response system**

The teacher presents the topic by giving a brief lecture to the students. The SRS is then used to show a series of multiple choice questions that each student is required to answer, using the clicker provided to them. Thereafter, the teacher publicly projects a histogram of the class responses; the student is then required to interpret this feedback in the light of the answer that they provided.

Depending on how the whole class answered, the teacher could ask the class to discuss their answer with the person next to them, and then adapt their action by answering the question again.

The teacher can then show the correct answer to the question; following this, the student must interpret the revised feedback in relation to their original conception and their revised actions. At this stage, the student has been given feedback about the correct answer to the question, as well as feedback about how they answered in relation to the rest of the class. The next activity is a reflection on their conception in relation to the task goal set by the teacher. By reflecting on this information, the student is able to give feedback to themselves on their level of understanding of the topic presented.

The final activity is for the teacher to extract the output data, showing how each student answered the questions presented. This information can be used to judge the level of understanding of the whole class, and is important feedback for the lecturer to decide on subsequent steps to take.

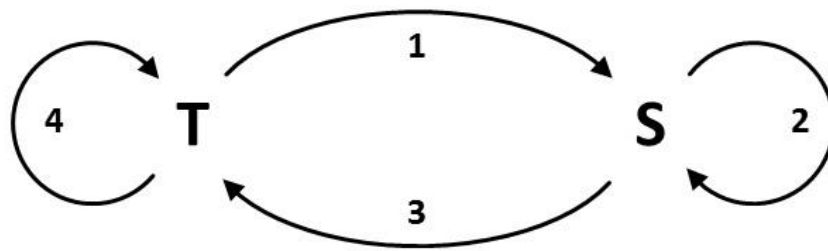
By creating a narrative line for the use of an SRS, it is possible to see the activities needed in order to support the learning processes as defined by the Conversational Framework.

### **2.7.7 Conversational Framework used in other studies**

Laurillard's Conversational Framework has been used in a number of studies that have looked at how student response systems are used the classroom.

Cutts, Carbone and Van Haaster (2004) used a simplified version of the framework to show how feedback and reflection are essential to the learning process. The dialogue nature of the framework was used at the discursive level to show how a teacher (T) presents knowledge to the students (S) who “processes, engages with, and reflects on the material received” (Cutts et al., 2004, p. 1). The students respond verbally to the teacher, and express their current understanding based on the material presented. The teacher is then able to use that information to assess the level of understanding of the students and adapt the teaching process accordingly, in order to meet the learning outcomes. The teacher can then start a new cycle.

This process is depicted diagrammatically in Figure 2.8 below:



***Figure 2.8 – A simplified version of Laurillard’s dialogue model  
(Cutts, Carbone and Van Haaster, 2004, p. 1)***

Unfortunately the model in Figure 2.8 is only described at the discursive level and does not include the interactive level where feedback is an integral part of the conversational dialogue. The framework was used in the study to show the theoretical importance of reflection and feedback, with minimal information about how the model could be used to guide the practical use of an SRS in the classroom.

Carnaghan and Webb (2007) investigated the effects of a student response system on student satisfaction, learning, and engagement in accounting education. In their study, they used Laurillard’s Conversational Framework to develop their hypothesis that a SRS will improve the interactive activities in class and therefore improve learning. The framework was also used to show that at the interactive level a student response system is able to provide immediate feedback on the quality of the students’ understanding. The results of the study showed that feedback should be provided only after the student has attempted to answer the task goal set by the teacher, as this ensures that the students are actively involved in the learning process.

A study by King and Robinson (2009c) focused on formative teaching, and used the conversational framework to evaluate the impact of response technology on student experience, engagement and achievement. The application of the Laurillard model showed how “response technology engenders learning via the iterative process of adaption and reflection and interaction between teacher and student” (King & Robinson, 2009c, p. 6). Their study used the framework because it was designed for evaluating learning technologies, which meant that it could be applied to evaluate the use of a student response system the classroom. It was useful in explaining from a theoretical perspective the factors that allow an SRS to impact the learning environment.

## **2.8 Response System Methodologies**

The final section of this chapter highlights certain methodologies that could be followed when studying the use of a student response system. The studies can be grouped into a number of categories, such as those presented below:

### **2.8.1 Survey based**

The use of a survey to collect data by means of a questionnaire with both open and closed questions allows for large scale studies to be conducted. This method is particularly useful in studies relating to the use of an SRS, as the clickers are often used in large classes of students who meet regularly together, making the administration of a survey relatively easy to conduct. The questions can be presented to the students in the classroom and the clicker device could be used to collect the student responses.

### **2.8.2 Case studies**

A case study should be “employed to gain an in-depth understanding of the situation and meaning for those involved” (Merriam, 1998, p. 19). This methodology is particularly relevant with respect to an SRS as often the implementation of new technology like clickers has an impact on the institution and other related entities, as well as on the individual students. A case study allows for the inclusion of a variety of viewpoints from different role-players, and this is important in providing a broader context to how an SRS could be used in the classroom.

### **2.8.3 Interviews**

Qualitative interviews, either semi-structured or open, are used in a number of studies and can be very valuable in understanding the students’ experience of the use of clickers in the classroom. Interviews allow for the possibility of asking the participants about the motives or meanings and can also be used to explore the variations in student perceptions of clicker usage (Hoekstra, 2008).

### **2.8.4 Literature reviews**

A comprehensive review of the current literature can be used to guide educators and future researchers. Response system technology is changing at a rapid rate, and an up-to-date literature review can provide a valuable summary of the benefits and challenges experienced when using this new technology (Kay & LeSage, 2009b).

### **2.8.5 Student performance**

The output data produced by the response system software can be analysed in order to determine the students’ performance. This information is usually available to the lecturer at the

end of the session in the form of reports and raw data which show how each student answered the questions presented to them. This data allows for a comparison of performance across sessions and different classes, as well as over time. Along with the lecture content, this data constitutes a record of the lecture as presented to the class and is a valuable and immediate resource (Cutts et al., 2004).

### **2.8.6 Mixed methods**

A critique of the research on student response systems has been the reliance on data from a single source, and therefore a number of the studies reviewed use a mixed methods approach in order to gather both qualitative and quantitative data. In certain circumstances using a triangulation of methods was found to be a more comprehensive research methodology (Fies & Marshall, 2006; Kay & LeSage, 2009b).

### **2.8.7 Phenomenography and Phenomenology**

Phenomenographic data collection usually revolves around interviews that are semi-structured, with an initial contextual question (Marton, 1981). The aim of phenomenography is to investigate and describe the qualitatively different ways in which people experience, understand and relate to phenomenon in the world (Marton & Booth, 1996). In phenomenographic studies, the object of investigation is the variation in the ways of experiencing the phenomenon, whereas with phenomenology the aim is to describe the phenomenon how it really is (Akerlind, 2005).

## **2.9 Summary**

This literature review firstly introduced the concept of assessment; however, it was difficult to define assessment without including the concept of feedback. The review then showed how different modes of feedback respectively define summative and formative assessment. The feedback provided by formative assessment can be seen as formative feedback. Formative feedback is difficult to manage in large classes, and one solution is to use a student response system. The review then showed how the Conversational Framework can be employed to guide the practise of using clickers in the classroom, by illustrating how the narrative line can be applied to create a sequential representation of the framework. The chapter ended with a brief discussion on the different research methodologies used in studies that have investigated the use of an SRS in large classes.

## Chapter 3 – Research Methodology

### 3.1 Introduction

This chapter describes the research methodology employed in this study. The chapter explains the purpose of the study, formulates the research question, and provides a brief explanation of the phenomenographic research approach used in this study. This is followed by an explanation on how the participants were purposefully selected, and by a detailed description of the data collection and data analysis phases. The chapter concludes with a discussion of the validity and reliability of the results, along with an account of the ethical considerations.

### 3.2 Purpose of the Study

The main aim of formative feedback is to increase knowledge, skills, and understanding, by indicating a gap between the actual knowledge of the student and the required standard. The purpose of this study was to gain a better understanding of students' perception of the use of a student response system to provide formative feedback in large classes.

### 3.3 Research Question

This study took a phenomenographical approach in order to gain a better understanding of students' experience of the use of an SRS to provide formative feedback in large classes. The research question was:

*What are the students' conceptions of the use of a student response system to provide formative feedback in a large class?*

### 3.4 Research Approach

This research is broadly situated within an interpretive paradigm, as the central objective is to understand the subjective world of human experience. According to Cohen, Manion and Morrison "an interpretive paradigm strives to understand and interpret the world in terms of its actors, and in order to retain the integrity of the phenomena being investigated, efforts should be made to get inside the person and to understand from within" (2007, p. 26).

This study adopts a phenomenographic research approach to the data analysis as well as to the way that the findings are presented.



### **3.4.1 Phenomenography**

Phenomenography is defined as “an empirically based approach that aims to identify qualitatively different ways in which people experience, conceptualise, perceive, and understand various kinds of phenomena” (Marton, 1988, p. 53). As a research methodology, phenomenography takes a “second-order approach” (Marton & Pang, 1999), or a “from-the-inside” approach (Richardson cited in Beutel, 2010, p. 78), in that it focuses on experiences as perceived by the participants (Ashworth & Lucas, 1998; Marton, 1988).

The phenomenographic method focuses on critical tasks within the topic concerned and uses semi-structured interviews with the participants in order to understand their experience of the phenomenon. Phenomenographic studies focus on describing and understanding the range of experiences of groups rather than on individual experiences (Harris, 2008; Marton, 1986).

In this study, a phenomenographic research approach was used in order to reveal the variation in the ways in which students in the class experienced the use of a student response system to provide formative feedback.

### **3.4.2 Semi-structured interviews**

Phenomenography uses semi-structured interviews that are recorded and transcribed verbatim, making the transcripts the focus of the analysis. Each interview begins with a contextual question that situates the interview within the context of the phenomenon being studied (Marton, 1986), and the purpose of the interview is to encourage the participants to talk about their experience. The interviews are then transcribed and analysed in order to produce a set of categories that are not determined in advance, “but rather emerge from the data, in relationship with the researcher” (Akerlind, 2005, p. 323).

### **3.4.3 Presentation of the findings**

The output of phenomenographic research is a set of ways of experiencing something that is characteristic for the population studied. These “ways of experiencing and their corresponding descriptive categories can then be ordered and related, and possibly hierarchically arranged, in order to produce the ‘outcome space’ of the phenomenon or concept being studied” (Marton, 1988, p. 104).

The outcome space provides a map of variations, and is represented as a visual or diagrammatic representation of the categories of description and the relationships between them (Marton, 1988). The descriptions of the categories and the relationships between them are

expected to assist with the understanding of the students' experience of the phenomenon – in this case the use of an SRS to provide formative feedback.

A phenomenographic research methodology is relevant to this study, as it allows for the focus of the research to be on the collective rather than on the individual experience, despite the fact that similar phenomena may be perceived differently by the same people and under similar circumstances (Akerlind, 2005). The methodology produces a rich set of data, in the form of categories of descriptions and thematic structural relationships, and these form the basis of the research findings.

### **3.5 Research Design**

In this section a brief description of the site selection, the general format of the class, the sampling strategy employed, the participant selection process, as well as an explanation of the data collection process is presented.

#### **3.5.1 Site selection**

The study was situated in the University of Cape Town, and the participants were all enrolled in the course INF1002H – “Fundamentals of Business Information Systems”. The course is taught over a full academic year, and in 2011 the students were required to attend two lectures, one tutorial and one practical session each week, as well as being required to hand in a number of written assignments during the year.

During the first semester of the year, the first two weeks consisted of an introduction to the course; thereafter the clickers were integrated into the lecture sessions, and this continued for the next eight consecutive weeks. In the first week of using the clickers, the students were introduced to the system and shown how to use the clickers, and the distinctive features of the system were explained to them. In the seven weeks that followed, the clickers were used every week to teach different aspects of the curriculum, and it is in this period that this research study was situated. The final three weeks of the semester consisted of normal lectures as well as summative assessments and final hand-ins of assignments and projects. The researcher was the sole lecturer for the INF1002H course and presented all the lectures during this period, including all those in which the clickers were used, and was therefore well acquainted with how the system was used in the classroom.

The response system used was purchased from Turning Technologies<sup>4</sup> which is supported locally in South Africa by Participate Technologies<sup>5</sup>. The model of clicker was the *ResponseCard RF* along with a USB RF Receiver. The software was *TurningPoint PC* version 4.3.2, provided by Turning Technologies that uses a proprietary add-on to integrate the TurningPoint functionality with Microsoft Office PowerPoint 2010. The clickers were owned by the Commerce Faculty Education Development Unit at the University of Cape Town, and each clicker was handed out at the beginning of each lecture and collected afterwards.

### **3.5.2 General format of the class**

Each lecture period was 45 minutes long, and the allocated starting time was 11h00 with the lecture having to end precisely at 11h45 so that the students could make their way to their next class.

As the students did not own the clickers, all the units were handed out to them as they arrived in class, and the TurningPoint software was set up so that each student was able to test their device as soon as they arrived. This was done in order to ensure that faulty units were swapped out before teaching began. This process took approximately five minutes. The next five minutes were used to make any necessary announcements and to introduce the main topic of the lecture.

The next 30 minutes were broken up into two sections of 15 minutes each. For the first 10 minutes, the students were given a brief lecture, followed by five minutes in which they answered questions using their clickers. Depending on the complexity of the questions and the understanding of the students, it was possible on average to ask four to five questions during each five minute period.

This brought the time to 11h40, allowing for five minutes in which the lecturer was able to review and summarise the teaching content. The clickers were then handed back to the lecturer as the students left the class at 11h45. On most days, a number of students stayed behind after class to discuss their concerns and to ask questions about the content presented, and once the students had left the class, the lecturer was able to use the TurningPoint Management Software to download the clicker responses for later analysis.

A lesson plan template of this process is attached as Appendix A.

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<sup>4</sup> <http://www.turningtechnologies.com>

<sup>5</sup> <http://www.participate.co.za>

Once the eight week period of teaching using the SRS was completed, the next step was to select students to be interviewed, in order to understand their experience of using clickers in the classroom. The sampling strategy used to select students to be interviewed is covered in the next section.

### **3.5.3 Sampling strategy**

Due to the fact that the focus of phenomenographic analysis is on the variation of the students' experience, it was important that the participants be selected with the intention of achieving as much variation as possible. As a result, this study used a purposeful sampling methodology in order to identify and select potential participants. According to Patton, "the logic and power of purposeful sampling lies in selecting information-rich cases [...] from which one can learn a great deal about issues of central importance to the purpose of the research, thus the term purposeful sampling" (Patton, 1990, p. 169).

The first step in the process of purposeful sampling was to ensure that the students who were interviewed had sufficient experience with using clickers, and to exclude those students who had not attended lectures where the clickers were used. A class register was handed out at each lecture period for INF1002H, and at the end of the semester the register showed that 62 of the possible 75 students attended all the lectures during the eight week period in which the clickers were used in class. This number was confirmed by extracting a session report from the Turning Technologies software which showed the total number of clickers that were used in each session. From the class register it was possible to see which students had attended each clicker lecture, and this information was then used to draw up a list showing the number of lectures attended by each student. The purpose of this process was to determine the total population of students that could potentially be interviewed, and to exclude those who had limited experience with using the clickers.

The next step was to address the possibility that not all students were comfortable with using the clicker device, and that perhaps those with little or no prior exposure to technology would have a different experience to those who had used computers before. Therefore, in order to maximise the variation, it was decided to group the students according to their prior experience with computers, and to then use purposeful sampling to ensure that there was at least one student interviewed from each group. This was done using the students Computer Literacy Course (CLC) test score. At the start of the year, each new first year UCT student is required to write a computer literacy test, and these scores are used to identify those students who need extra help during the first semester with using a computer. This test is a good indicator of their

prior experience, as well as a measure of familiarity with technology. Knowing each student's test score would ensure that not only the top students were selected to be interviewed for this study, and would also ensure that a range of students were selected, thereby increasing the variation of the experiences.

A final criterion was the attempt to ensure that there was a 50/50 split between males and females interviewed. This was done as an extra measure to ensure variation.

It is important to note that the gender of the student, as well as all the other criteria mentioned above, were used to try to ensure a phenomenographic variation in the interviewees only. It was not the intention to use these criteria in the data analysis phase.

#### **3.5.4 Participant selection**

Each student was given a generic letter, asking them if they would be prepared to participate in this research study (see Appendix B); this letter was followed up two days later with an identical letter via email to each student. On the Monday of each week during the study, an announcement was made in class explaining the terms of the research, and a request was made for students to volunteer if they wished to participate in the study.

In all the different forms of communication, the students were asked to forward their names via email to me if they were prepared to volunteer to participate, and no student was asked directly to be part of the study. It was explained to the students that only a limited number of interviews would be conducted, and therefore not all students who volunteered would be interviewed.

The result of this process was that fourteen students offered to be interviewed, and eleven students, consisting of five males and six females, were then purposefully selected using the sampling methodology described above. The computer literacy scores of the students selected ranged from 60% being the second lowest mark in the class, to the joint top score of 100%. Each potential interviewee was sent a confirmation email, and a date and time for the interview was set up that suited both the researcher and the interviewee. The email included an attachment containing a copy of the research consent form (see Appendix C) that they were asked to sign and bring along with them to the interview.

A final email was then sent to all the students in the class thanking them for being willing to participate in the study and letting them know that no more participants were needed for the study.

## **3.6 Data Collection**

The data collection procedure consisted of a pilot study, conducting the interviews with the selected participants, and of an explanation of how the data was managed after each interview was completed.

### **3.6.1 Pilot study**

Before the student interviews took place, two pilot interviews were conducted with a consenting participant who was not a member of the INF1002H class. The purpose of the pilot interviews was for the researcher to develop the skills needed to perform a phenomenographic interview, as well as providing an opportunity to refine the interview protocol that would be used during the student interviews. The interview protocol, as well as the contextual question, is provided as Appendix D.

Conducting two pilot interviews with the same participant allowed for the interviewee to provide feedback to the researcher about how the interview was conducted. This information was then used by the researcher to improve the interviewing process. The pilot interviews were recorded and transcribed, although the resultant data was not analysed and did not form part of the research findings.

### **3.6.2 Participant interviews**

Before the student interviews were conducted, each interviewee was allocated a pseudonym which was taken from a list of names that had previously been created as part of the research design process. Two lists of names were created, one for males and one for females, and each list had one name for each letter of the alphabet. The first interviewee was allocated a name that started with the letter A, the second interviewee was allocated the letter B and so on. The only difference was that the male interviewees were allocated a name from the list of male names, and the females were allocated a name from the list of female names.

The rationale for this decision was that allocating the names alphabetically would allow for the order of the interviews to be easily determined, and that knowing the gender of the interviewee would allow for the words 'he' and 'she' to be correctly applied when referring to the interviewee.

For this study, the names pre-allocated to the interviewees were as follows:

Interviewee	Pseudonym	Gender
1.	Ayanda	Male
2.	Bongani	Male
3.	Cebile	Female
4.	Dowelani	Male
5.	Edzai	Female
6.	Fikile	Female
7.	Gloria	Female
8.	Hana	Female
9.	Itumeleng	Female
10.	Jeremia	Male
11.	Kenneth	Male

***Table 3.1 – Pre-allocated pseudonyms***

The purpose of allocating a pseudonym to each interviewee was to ensure that the identities of the students did not become part of the research artefacts, and that confidentiality could be ensured as agreed upon in the interview request letter (see Appendix B). Using pseudonyms in this manner meant that the only data that could be determined from the allocated names was the order of the interview and the gender of the interviewee. It was felt that knowledge of this information did not compromise the confidentiality of the interviewee as agreed upon with each participant.

### **3.6.3 Data management**

Each interview was recorded using an Olympus Digital Voice Recorder model VN-3100PC<sup>6</sup>. This model of recorder was selected as it allowed for the recording to be saved as a digital WAV file which could then be easily transferred to a Microsoft Windows PC using software provided by the maker of the digital recorder.

Immediately after each interview was completed, the recorder was connected to a PC via a USB cable, and the WAV file was transferred to a computer running Microsoft Windows. This meant that the interview was immediately available in digital format and allowed for the recording to be backed up and stored apart from the digital recorder.

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<sup>6</sup> [http://www.olympus-europa.com/consumer/2581\\_vn-3100pc.htm](http://www.olympus-europa.com/consumer/2581_vn-3100pc.htm)

After the WAV file had been transferred to the Windows PC, an electronic folder was created and was named to match the allocated pseudonym. The corresponding digital recording WAV file was placed in the correct folder, and the file name of the recording was changed to match the allocated pseudonym. The date of the interview, as well as the start and end time of the interview, was captured on an interview control sheet. Any other relevant information about the interview was also captured on this control sheet.

Immediately after this process was completed, the digital recording was emailed to an external transcription service in order to be transcribed. After a couple of days, the transcription service produced a Microsoft Word document containing a verbatim transcript of the recorded interview, and this document was placed in the correct folder along with the original digital recording WAV file.

### **3.6.4 Data source**

The final outcome of the data collection process was that ‘Jeremia’ failed to arrive for the interview and ‘Gloria’ and ‘Hana’ chose to come together, which meant that a total of ten students were interviewed, producing nine recorded interviews and associated transcripts.

A summary table of the interviews conducted is presented below:

Interview	Pseudonym	Date	Duration	Transcription	Quotations
1.	Ayanda	3/6/2011	19 minutes	4237 words	141
2.	Bongani	3/6/2011	22 minutes	3609 words	114
3.	Cebile	8/6/2011	15 minutes	2612 words	60
4.	Dowelani	8/6/2011	23 minutes	3280 words	156
5.	Edzai	8/8/2011	22 minutes	3805 words	136
6.	Fikile	19/8/2011	15 minutes	2163 words	60
7.	Gloria & Hana	23/8/2011	19 minutes	3305 words	88
8.	Itumeleng	26/8/2011	14 minutes	2568 words	87
9.	Kenneth	31/8/2011	12 minutes	1797 words	47

***Table 3.2 – Summary of the interviews conducted***

These nine interview transcripts became the empirical data source for the qualitative data analysis phase.



### 3.7 Data Analysis

The next step in the process was to analyse the empirical data collected. Sjöström and Dahlgren (2002) describe a number of consecutive steps to guide the phenomenographic data analysis process, and these steps provided a framework for the data reduction phase of this study. The process followed for this study is documented below, along with a short description of each step in italics.

#### **Step 1: Familiarisation**

*Familiarisation means that the researcher is introduced to the empirical material by reading through the transcripts. The familiarisation phase is also necessary for correcting errors in the transcripts* (Sjöström & Dahlgren, 2002, p. 341).

The first step in the data analysis phase started with taking each individual transcript and converting the document to plain text in order to remove any unnecessary formatting that was added by the transcription service. Each transcript was then read through a number of times in order to become familiar with the written transcript. The recorded interview was then listened to while the associated transcript was read, and any transcription errors were corrected.

Once this was completed, the recording was listened to again, and punctuation was added to the transcription document in order to better reflect the context of the spoken words. This included adding commas and full stops, and punctuation to show pauses and breaks in the conversation. The output of this step was the creation of nine Microsoft Word 2007 documents, each containing a verbatim transcript of each interview.

#### **Step 2: Compilation**

*The second step involves the compilation of all relevant elements from all respondents.*

Each Microsoft Word document was then added as a primary document to a qualitative data analysis software package called ATLAS.ti<sup>7</sup>. It was decided to use specialised data analysis software for this phase of the project, as such software is “a visual qualitative data analysis tool that provides a means to segment documents into quotations and to define codes” (Nicolle & Lou, 2008, p. 246). ATLAS.ti (version 6.2) allows for the creation of a single project file, called a Hermeneutic Unit (HU) that maintains the pathways to the individual source data and stores the quotations, codes, code families and network views created during the course of the data analysis. A single HU project file was created, and each Microsoft Word transcription

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<sup>7</sup> <http://www.atlasti.com>

document was added to the HU along with the associated WAV file of each recorded interview.

The relevant documents were then associated with each other. Creating associated documents in ATLAS.ti means that the audio recording can be linked to the transcript at defined points in the two files, making it easy to quickly locate any point of the recording from within the associated transcript. Using ATLAS.ti in this manner meant that the consolidation, reduction and grouping steps that followed could take place in a single repository, without losing direct access to the original transcripts and interview recordings.

The output of this step was a single consolidated Hermeneutic Unit in ATLAS.ti, containing all the relevant source documents and recordings as indicated in Figure 3.1 below.

Id	Name	Media	Quotations	Author	Created	Origin	Families
P 1	Ayanda	Rich Text << DOC	141	IanB	14/07/2011 04:29:33 PM	<HUPATH>\Ayanda TEXT.doc	Interview Transcripts
P 2	Bongani	Rich Text << DOC	114	IanB	14/07/2011 04:33:06 PM	<HUPATH>\Bongani TEXT.doc	Interview Transcripts
P 3	Cebile	Rich Text << DOC	60	IanB	14/07/2011 04:33:11 PM	<HUPATH>\Cebile TEXT.doc	Interview Transcripts
P 4	Dowelani	Rich Text << DOC	156	IanB	14/07/2011 04:33:20 PM	<HUPATH>\Dowelani TEXT.doc	Interview Transcripts
P 5	Edzai	Rich Text << DOC	136	IanB	21/09/2011 04:32:15 PM	<HUPATH>\Edzai TEXT.doc	Interview Transcripts
P 6	Fikile	Rich Text << DOC	60	IanB	21/09/2011 04:32:47 PM	<HUPATH>\Fikile TEXT.doc	Interview Transcripts
P 7	Gloria & Hana	Rich Text << DOC	88	IanB	21/09/2011 04:32:57 PM	<HUPATH>\Gloria-Hana TEXT.doc	Interview Transcripts
P 8	Itumeleng	Rich Text << DOC	87	IanB	21/09/2011 04:33:05 PM	<HUPATH>\Itumeleng TEXT.doc	Interview Transcripts
P 9	Kenneth	Rich Text << DOC	47	IanB	21/09/2011 04:33:12 PM	<HUPATH>\Kenneth TEXT.doc	Interview Transcripts
P10	Ayanda.wav	Audio	0	IanB	19/07/2011 10:29:13 AM	<HUPATH>\Ayanda.wav	Recorded Interviews
P11	Ayanda-Intro.wav	Audio	0	IanB	19/07/2011 09:14:53 AM	<HUPATH>\Ayanda-Intro.wav	Recorded Interviews
P12	Bongani.wav	Audio	0	IanB	19/07/2011 02:51:11 PM	<HUPATH>\Bongani.wav	Recorded Interviews
P13	Cebile.wav	Audio	0	IanB	19/07/2011 02:51:15 PM	<HUPATH>\Cebile.wav	Recorded Interviews
P14	Dowelani-Part1.wav	Audio	0	IanB	19/07/2011 02:51:18 PM	<HUPATH>\Dowelani-Part1.wav	Recorded Interviews
P15	Dowelani-Part2.wav	Audio	0	IanB	19/07/2011 02:51:23 PM	<HUPATH>\Dowelani-Part2.wav	Recorded Interviews
P16	Edzai.wav	Audio	0	IanB	18/09/2011 04:56:56 PM	<HUPATH>\Edzai.wav	Recorded Interviews
P17	Fikile.wav	Audio	0	IanB	18/09/2011 04:57:12 PM	<HUPATH>\Fikile.wav	Recorded Interviews
P18	Gloria-Hana.wav	Audio	0	IanB	18/09/2011 04:57:20 PM	<HUPATH>\Gloria-Hana.wav	Recorded Interviews
P19	Itumeleng.wav	Audio	0	IanB	18/09/2011 04:57:30 PM	<HUPATH>\Itumeleng.wav	Recorded Interviews
P20	Kenneth.wav	Audio	0	IanB	18/09/2011 04:57:43 PM	<HUPATH>\Kenneth.wav	Recorded Interviews

**Figure 3.1 – ATLAS.ti Hermeneutic Unit containing all relevant primary documents**

### Step 3: Condensation

The third step is a condensation or reduction of the individual answers to find the central parts of longer answers or of a dialog. “This phase of the analysis is a kind of selection procedure based on criteria of relevance where utterances found to be of interest for the question being investigated are selected and marked” (Akerlind, 2005, p. 325).

The next step of the data analysis phase was to identify and extract all relevant quotations from all the transcribed interviews in order to create a single list of distinct quotations. ATLAS.ti

allows for a section of text to be selected and then marked as a free quotation, which can then be managed using the Quotation Manager. Each interview transcript was opened, and all relevant quotations were highlighted and added to the Quotation Manager. Any longer responses, containing multiple quotations, were broken up into distinct phrases or quotations in order to ensure that each quotation represented a single aspect of the student's experience.

Extracting the quotations before coding took place was a valuable experience as it meant that it was possible to understand the full context of each individual document before considering categories that cut across the whole project (Maietta, 2009). The final output of this step was a list of 889 distinct quotations that described the students' conception of their experience of using clickers in the classroom.

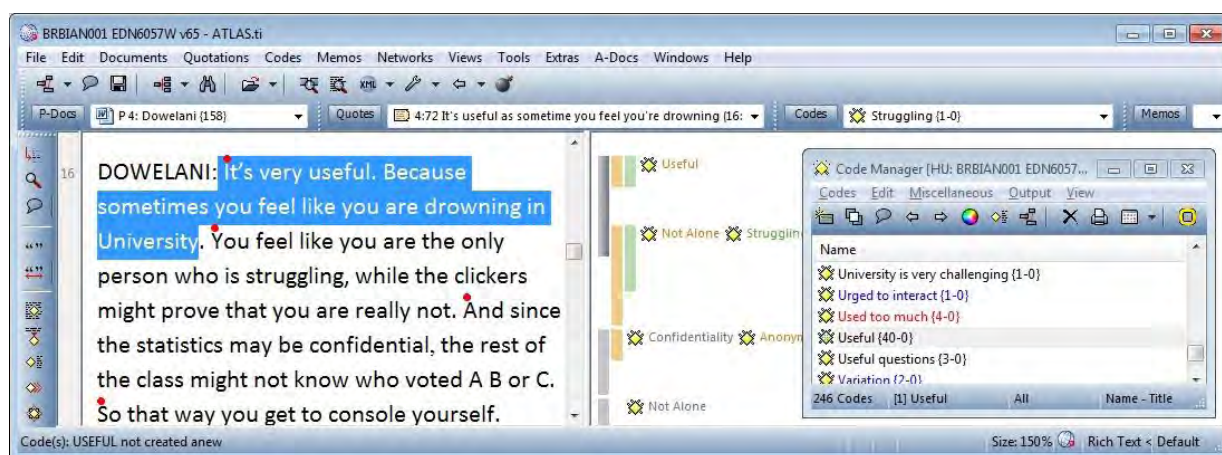
#### **Step 4: Grouping**

*The fourth step involves a preliminary grouping or classification of similar answers. "The researcher's attention has now shifted from the individual subjects (i.e. from the interviews from which the quotes were abstracted) to the meaning embedded in the quotes themselves" (Akerlind, 2005, p. 326).*

The next step involved taking the list of 889 quotations and paraphrasing each quotation into a phrase of 50 characters or less. The reason for this step was that the extracted quotes were a verbatim extract from the interview and a number of quotations were too long to be manageable. (The longest quote was 385 characters, and the average length was 79 characters). The process of allocating a short description for each quotation allowed for the essence of the quotation to be captured into a field that could then be used to group similar quotes together. The short description was stored in ATLAS.ti as the Quotation List Name, and the limit of 50 characters was guided by ATLAS.ti which recommends that all list names be between 30 and 50 characters. Double-clicking the list name in ATLAS.ti displayed the transcript with the full quotation highlighted in blue, which meant that the short description could be used to group the quotations, while the original quotation in the context of the interview transcript was still visible.

Once this was completed, each quotation was read in order to determine if the utterance was negative, positive or neutral. Making use of the "Code by List" functionality in ATLAS.ti, this categorisation was then added as a code to each quotation. Knowing the tone of the utterance was seen as an important aspect of understanding the experience of the students and would allow for all positive, negative and neutral statements to be easily identifiable.

Each quotation was then re-read and allocated a single word or short phrase that best reflected the meaning of the quotation. These were added as codes using the “Open Coding” functionality in ATLAS.ti. If the quote had multiple meanings, the quotation was allocated to two or more different codes. The codes used were descriptive words that emerged from the data and were not predefined or pre-allocated. This was in line with phenomenographic data analysis which requires the categories to emerge for the text (Akerlind, 2005).



**Figure 3.2 – Using the ATLAS.ti Code Manager to code quotations**

A summary of this step of the data analysis was that each quotation was allocated a short description, was coded according to the tone (positive, negative, or neutral) and was preliminarily assigned a descriptive code according to the meaning of the utterance. One hundred and eighty four quotations were coded as positive; 409 coded as negative; and 296 quotations were coded as neutral statements. The outcome of the coding process was that the original list of 889 quotations was now grouped according to 246 codes.

### **Step 5: Preliminary comparison**

*The fifth step is a preliminary comparison of categories, where the researcher tries to establish borders between the categories. This is a phase which sometimes entails revision of the preliminary groups.*

Each of the resultant 246 codes were compared to each other in order to identify codes that were identical in meaning to one another. These codes were then merged together using the ‘Merge Codes’ functionality in ATLAS.ti. This process eliminated any code spelling errors and also allowed for singular and plural codes to be merged into a single code. In ATLAS.ti the process of merging codes automatically moves all linked quotations from one code to another, so the merge process kept the links intact, and this meant that no quotations were left un-coded.

The next task was to interrogate the list of codes and the linked quotations in order to bring together codes on the basis of their similarities. This process was simplified by making use of the ATLAS.ti 'Code Family Manager'. All quotations with a similar set of descriptive codes were extracted and read together to see if the linked quotations were similar. Similar codes were then allocated to an existing code family, a new code family was created when required, and different quotations were re-coded by moving the codes across code families. This process was iterative until all codes had been allocated to a code family and all borderline cases had been examined and allocated.

The process is similar to one where "quotes are sorted into piles, borderline cases are examined, and eventually the criterion attributes for each group are made explicit" (Marton, 1986, p. 42). In this study the task was performed in ATLAS.ti using the 'Codes' and 'Code Families' functionality and not by physically sorting the quotes into piles.

As similar code families were merged and refined, and allocated codes and quotations were re-examined, a stable set of categories eventually emerged from the text. The emergent code families were then examined in order to ensure that they were sufficiently differentiated according to their differences, and where necessary, codes were moved across code families. When necessary, the functionality in ATLAS.ti allowed for the quotation to be read in the context of the original transcript, while also allowing for the exact segment of the interview to be listened to. This meant that the context of the quotation became the deciding factor when moving codes across categories.

The output of this step was a set of five distinct code families that would eventually become the phenomenographic categories of description.

### **Step 6: Naming**

*The sixth step consists of naming the categories to emphasise their essence.*

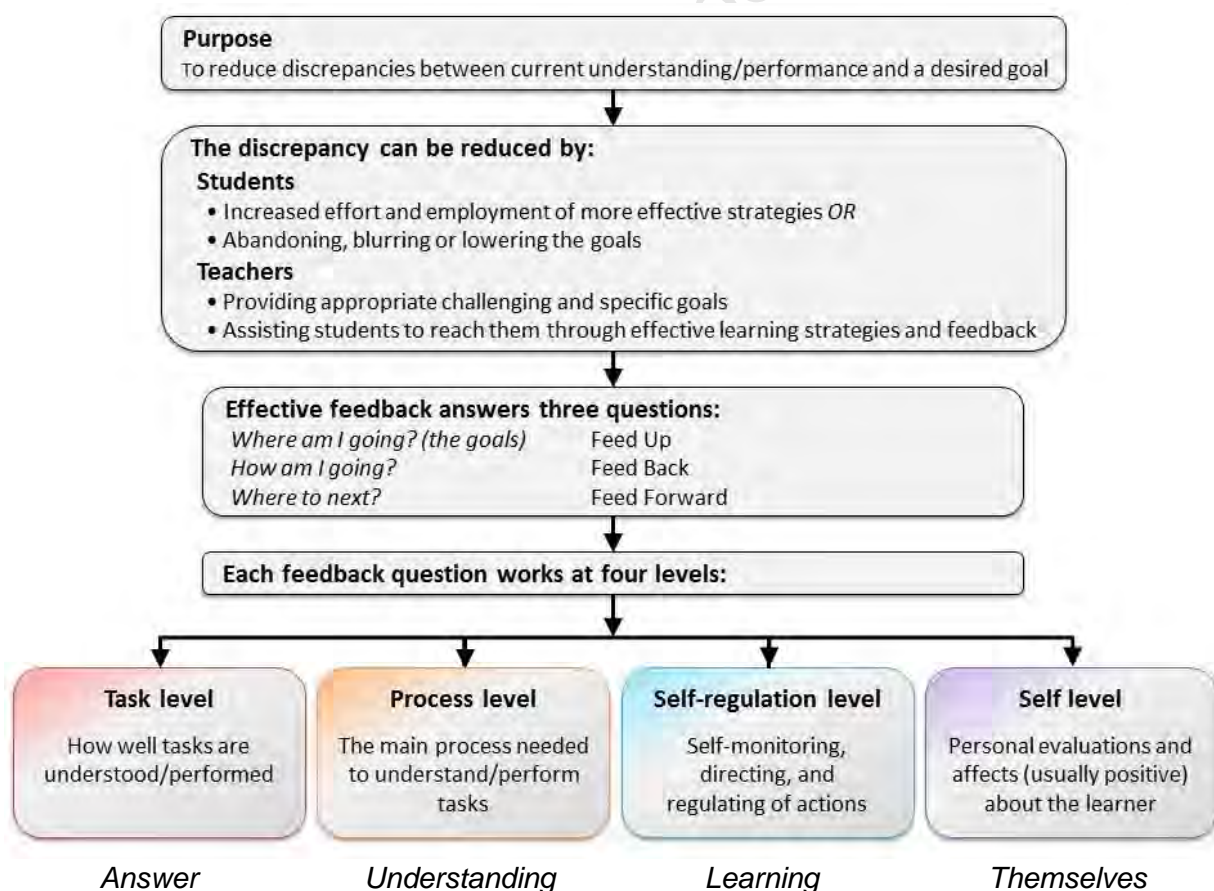
At this stage in the process a clear distinction was emerging from the codes within a category, and the five code families were initially given names that described the group of codes and quotations. Their initial allocated names were as follows:

1. The word **answer** was allocated to the group of codes that related to feedback about the correct answer.
2. **Understanding** was the word allocated to the quotations that spoke about receiving feedback that helped students understand the topic presented.



3. **Lecturer** was allocated to the group of quotations where the students described their experience when the clickers provided feedback meant for the lecturer.
4. **Learning** was given to the grouping that mentioned feedback that helped with the process of learning.
5. The word **themselves** was allocated to quotations where the students mentioned receiving feedback about themselves as a person.

In order to provide a better understanding of these categories, literature related to feedback as well as literature about the use of clickers in the classroom was examined. One journal article was found to be particularly relevant, namely “The Power of Feedback” (Hattie & Timperley, 2007), as it provided a model of feedback that was deemed to match four of the above five categories very closely. The model proposed that effective feedback answers three questions and works at four different levels. The four levels were used to guide the naming of the categories that emerged from the data analysis in this study and also provided a description of the categories. The model is presented below:



**Figure 3.3 – A model of feedback to enhance learning**  
(Hattie & Timperley, 2007, p. 87)

### **Step 7: Contrastive comparison**

*The seventh and last step is a contrastive comparison of categories, which contains a description of the unique character of every category as well as a description of resemblances between categories.*

The final step was to describe each category in detail, using quotations taken from the transcripts in order to show the distinct characteristics of each category. These descriptions and comparisons are presented in detail in Chapter 4 – Findings.

## **3.8 Threats to Validity**

Validity is “widely regarded as the extent to which a study is seen as investigating what it aimed to investigate, or the degree to which the research findings actually reflect the phenomenon being studied” (Akerlind, 2005, p. 330). Sandberg (1997) proposes three phases in the phenomenographic process that can assist with ensuring validity, namely:

1. Within the interviews communicating with the subjects;
2. In the analysis process communicating with the text;
3. In communicating the results and conclusions.

### **3.8.1 Communicating with the subjects**

Prior to each interview, each student was told that the purpose of the interview was to develop a conversation about their experience of using clickers in the classroom. They were told that there were no pre-determined questions, that there were no right or wrong answers, and that no personal judgements would be made. Each interview started with an open-ended question and, in-line with a phenomenographic approach, the interview was purposefully not a question and answer session. Each interviewee was encouraged to simply talk about their experience, and the role of the interviewer was to stimulate discussion and to ask for clarity when needed. A key element of phenomenography is that the interviewer does not impose their views on the subject or even provide hints about what the interviewer finds interesting or important about what is being said, and this was strictly adhered to in all the interviews.

As a result, all of the experiences expressed during the interview were accepted as valid and were not criticised or contradicted. As the interviewer, I was aware of all these aspects during the interview and made sure that none of these elements threatened the validity of the phenomenographic interview.

### **3.8.2 Communicating with the text**

An important aspect of a phenomenographic approach is to ensure that the transcripts are analysed in the correct manner. A detailed explanation of this process is covered in Section 3.7 – Data Analysis. Transcripts were always viewed as a whole rather than quotations taken out of context, and this was especially relevant when the quotations were extracted from the text in order to be grouped with similar such quotations. Before a particular quotation was coded, the context of the quote within the original transcript was always first taken into account. This was possible by making extensive use of the ATLAS.ti software to perform the data analysis. Using specialised software like ATLAS.ti meant that it was easy to compare similar quotations with one another, while each quotation could still be read within the context of the original transcript. This was seen as an important aspect of the data analysis and was done as a means of ensuring the validity of the codes and categories that emerged from the text.

### **3.8.3 Communicating the results**

The third aspect of validity involves presenting the results and conclusions in a manner that allows for others to judge for themselves the credibility of the results (Marton & Booth, 1996). In this study, this has been achieved by documenting the phenomenographic data analysis phase in as much detail as possible in order to show how the findings were arrived at. This is presented in Section 3.7 – Data Analysis. To supplement the data analysis process, the full interview transcripts are available electronically, and a full transcript of one of the interviews is included in this report (see Appendix E – Interview Transcript for Dowelani).

The findings are phenomenographically described in Chapter 4 and include extracts from the student interviews in order to support the findings presented. These elements all contribute towards ensuring that others are able to judge for themselves the credibility of the results obtained.

## **3.9 Reliability**

Reliability in phenomenographic studies revolves around “the researcher’s interpretive awareness” and how “interpretations have been controlled and checked throughout the research process” (Sandberg, 1997, p. 209). The stages of this research where this was particularly relevant were as follows:

### **3.9.1 The formulation of the research question**

The research question for this study asked: “What are the students’ conceptions of the use of a student response system to provide formative feedback in a large class”. The purpose of this



question was not to validate a theory or to test a predefined assumption, but was rather an exploration of the variations of experience that existed among the students who used the response system in the classroom. This is in line with a phenomenographic approach, as the focus is on the experiences of a group as a whole. Reliability in this study is enhanced by formulating a question that can be used to elicit the experience of those involved, rather than asking a question with a definitive answer. And in this study this is deemed to be the case.

### ***3.9.2 The selection of the subjects***

As discussed in Section 3.5 (Sampling strategy), the students were selected for the study with the intention of achieving as much variation as possible. A purposeful sampling methodology was used to try and select students of both genders, and students who had varying degrees of experience with technology. Unfortunately, the study was restricted to a single class of first year students, which meant that it was not possible to use other criteria like age or educational background as selection criteria, but these factors were not seen as determinants that affected the reliability of the study.

### ***3.9.3 Interviewing the selected subjects***

Before the interviews were conducted, two pilot interviews were conducted in order to develop the skills required for this type of phenomenographic interview. The main purpose of the pilot interviews was to ensure that no leading questions were asked, and that there was no bias created by the interviewer when talking to the interviewee. The outcome of this process was an interview protocol as well as a single initial contextual question (see Appendix D). This ensured that the interviews were as consistent as possible while still being open-ended and thus allowing each person to freely express their unique experience of the phenomenon.

### ***3.9.4 Analysing the transcripts***

For the purpose of reliability in phenomenographic studies, there are a number of important factors that need to be highlighted with regards to the analysis of the transcripts. The first is that the source of the data needs to be interview transcripts, and in this study this was adhered to, as the nine verbatim transcripts were the only data source that was analysed in order to determine the categories of description.

Secondly, during the data analysis there was a constant referral back to the original transcript in order to ensure that the quotations were not read in isolation. As mentioned in Section 3.8 on validity, this was made possible by using specialised software. The literature refers to this as “two sides of the same coin”, where the parts (or quotations) must be referred to other similar

parts, but then at the same time must also be compared to the context of the part in the original transcript (Marton & Booth, 1996).

And thirdly, it must be ensured that the categories are produced in an iterative fashion. As shown in Section 3.7, the data analysis phase required numerous iterations of coding and grouping, and then recoding and merging codes when required. It was not a linear process of reduction in order to produce a predefined outcome. The focus was on investigating the inconsistencies in the transcripts in order to understand the variation of the experiences, rather than on trying to make the data appear consistent.

### **3.9.5 Reporting the final Categories of Description**

The final aspect of reliability is making sure that the set of categories are presented as a hierarchical outcome space and are described in detail, using quotations from the original transcripts. This information is presented in Chapter 4 – Findings.

## **3.10 Ethical Considerations**

Participation in the study by the students was optional, and the responses from the students remained confidential at all times. All participants were allocated a pseudonym, and this name was used throughout the data analysis phase in order to ensure that no names or personal information was inadvertently used.

Although participants were selected using ‘purposeful sampling’ and were therefore approached to be part of the study, they were still free to decline without prejudice and were also informed that they could withdraw from the study at any time.

Those participants who did agree to be interviewed were required to provide their verbal consent to being part of the study at the beginning of the recorded interview and were also informed that their participation was optional and they could withdraw from the study at any time. After the interview was completed and transcribed, a copy of the transcription was given to each participant, and their written consent was requested in order to obtain their permission to use the transcribed data. This approach allowed each participant to know exactly what information would be used in the research study, and also gave them the opportunity to clarify any concerns they had relating to the transcription. A copy of the consent form (Appendix C) was given to each participant, signed by them, and was placed on file at the University of Cape Town.

### **3.11 Summary**

This chapter focussed on the research methodology used in this study, with particular emphasis on the phenomenographic approach to the data collection and data analysis phases. The chapter showed how semi-structured interviews were used to collect the data from students purposefully selected to be part of the study, and how this data was analysed in order to produce five categories of description. These five categories along with the associated structural themes make up the phenomenographic outcome space and these elements are described in detail in Chapter 4.

University of Cape Town

# Chapter 4 – Findings

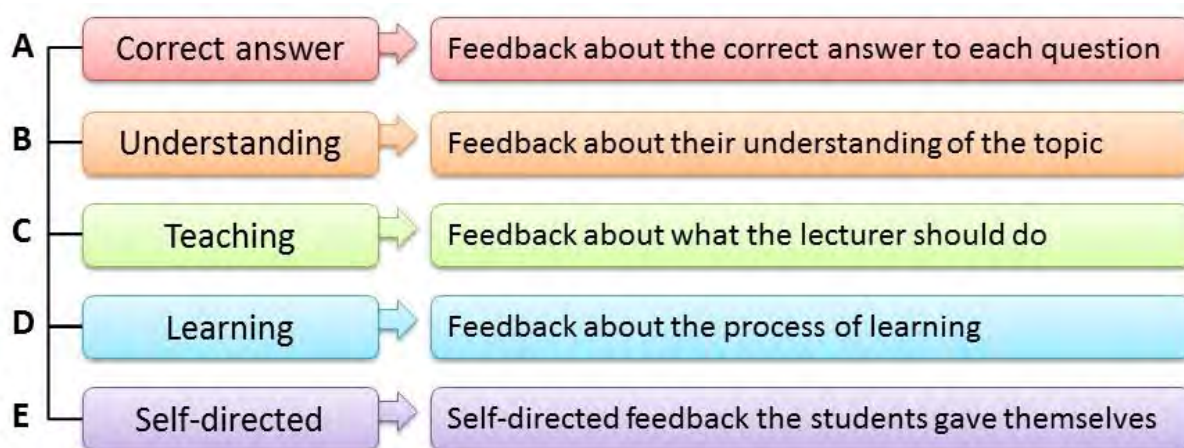
## 4.1 Introduction

Chapter 4 presents the findings of the phenomenographic data analysis phase described in the previous chapter. The chapter provides a brief overview of each of the five categories of description, followed by a presentation of a summary of the phenomenographic outcome space in form of a table that shows the categories of description, along with a short description of the structural themes for each category. The categories of description are then explained in detail, using extracts from the student interviews to illustrate the critical aspects of each category. Subsequently, the structural relationships between the categories are presented as themes, showing the similarities and differences between the categories. The chapter ends with a brief discussion of the findings presented.

In this chapter, quotations taken from the interview transcripts are accompanied by references such as the following: [Ayanda, 1:10, line 35]. This denotes that the extract is from the interview with student pseudonym Ayanda; taken from interview 1, quote number 10; found on line 35 of the associated transcript. The square brackets are used to differentiate the interview quotations from references to literary sources.

## 4.2 Categories of Feedback

The data from this study revealed five distinctly different categories of feedback that the students experienced when using a student response system in the classroom. The categories of feedback that emerged from the data analysis phase are presented diagrammatically in Figure 4.1 below, followed by a brief description of each category.



*Figure 4.1 – The five categories of feedback experienced by the students*

Each category represents a qualitatively different way of experiencing the phenomenon, and the categories are ordered in a decreasing degree of importance as described by the students.

The categories of feedback that emerged from the data analysis are as follows:

***Category A: Feedback about the correct answer to each question***

The first category focuses on the experience of the student when they received feedback about the correct answer to each question that was asked. This type of feedback ensures that students are able to “distinguish correct answers from incorrect answers, to acquire more or different information, and to build more surface knowledge” (Hattie & Timperley, 2007, p. 93).

***Category B: Feedback about their understanding of the topic***

The next category of feedback focuses on helping students to determine their level of understanding of the topics that were presented. “A deep understanding of learning involves the construction of meaning (understanding) and relates more to the relationships, cognitive processes, and transference to other more difficult or untried tasks” (Hattie & Timperley, 2007, p. 92).

***Category C: Feedback about what the lecturer should do***

This category relates to feedback that allows the lecturer to understand the needs of the class and to respond accordingly. Using an SRS in the classroom gives a lecturer the opportunity to observe many aspects of learning in the classroom, including knowing immediately how much the students understand, what they are finding difficult, and what areas they have easily understood. This information allows lecturers to make the structure of the lecture dependent upon the actions of the students, rather than following a pre-determined sequence (Draper & Brown, 2004). In this study, the experience of the students was that by using clickers in the classroom they were made aware of this type of feedback, and although they were not able to act upon it, they did see it as a relatively important part of their experience.

***Category D: Feedback about the process of learning***

Students in this study experienced receiving feedback about how clickers helped them understand more about the learning process. This type of feedback “addresses the way students monitor, direct, and regulate actions toward the learning goal” (Hattie & Timperley, 2007, p. 93). Such regulation also involves “self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals” (Zimmerman, 2000, p. 14).

### Category E: Self-directed feedback the students gave themselves

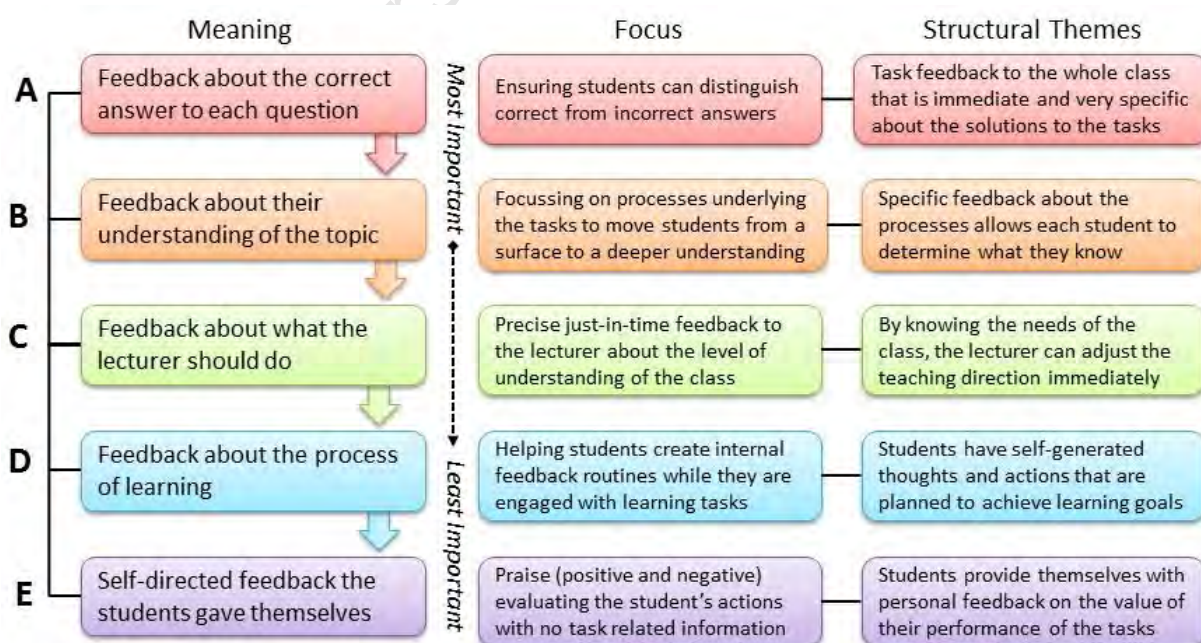
The final category covers feedback that the students gave themselves during the process of using the clickers based on how they perceived the value of their performance of the tasks. Personal feedback often contains little task-related information and comprises more self-directed feedback, resulting in feedback that is ineffective in enhancing learning (Hattie & Timperley, 2007).

## 4.3 Summary of the Outcome Space

A core premise of phenomenography is the notion that the different categories of description are logically related to one another, typically by way of hierarchically inclusive relationships; the categories of description and the structural relationships are together referred to as the 'outcome space' (Marton & Booth, 1996).

Figure 4.2 describes the outcome space for this study, showing the categories of feedback that the students experienced when using a student response system in the classroom. The diagram shows the meaning (or referential) aspect of each category, along with the focus of the category, as well as showing the structural themes that define each category.

The rows in the diagram are hierarchically related, with the first category seen as the most important category of feedback, and the subsequent rows listed in decreasing levels of importance to the students in terms of the type of feedback received.



*Figure 4.2 – Outcome space showing the ways students experienced feedback*

Each of these categories is described in detail in the following section, along with selected quotes from the student interviews to illustrate each category.

## 4.4 Categories of Description

### Category A: Feedback about the correct answer

The first category relates to the students receiving feedback about the correct answer to each question that was asked. This was described as *“you'd ask the question and we all attempt it and you achieved a little ring or a little tick or something, and it would rise up next to the answer”* [Ayanda, 1:10, line 35].

Three features of the student response system that the students found effective were:

1. The students could see the correct answer immediately after they answered.
2. The visual elements meant that they knew with certainty if their own answer was right or wrong.
3. They could see a graph of how the class responded.

The first aspect was that the student response system ensured that the correct answer was immediately displayed for the whole class to see:

*“We all click, you wait for a couple of seconds, and then you see it come up”*  
[Ayanda, 1:102, line 93].

*“You see an immediate response and you get conviction, when your answer is right or wrong, immediately”* [Dowelani, 4:69, line 4].

Secondly, they knew with certainty if their own answer was right or wrong. The students expressed the importance of knowing if they answered correctly, and their experience with clickers was that *“you get to see your answer immediately like am I wrong or right”* [Itumeleng, 8:9, line 19]. So while the immediacy of the feedback was valued, so too was the fact that it was shown visually on the screen, and these aspects were regularly described by the students as a single experience. One student referred to this in his own words as *“immediate picture memory”*:

*“The picture memory of looking at the screen, and seeing this little circle ... as it stops it's on B, and B was that, so you will remember. That immediate picture memory – that was amazing”* [Ayanda, 1:106, line 95].

The experience of “*picture memory*” was expressed by others using words such as “*seeing*”, “*it showed*”, “*I saw*”, “*was visible*”, “*I was able to see immediately*”, and their experience was that “*picture memory is stronger than word memory*” [Ayanda, 1:9, line 35]. The TurningPoint software was able to provide visual feedback to the class, and this enhanced the experience for the students and was seen as being very helpful in ensuring that they knew what the correct answer was.

The third aspect was that they could see how the whole class responded. After displaying the correct answer, the next step of the process was to show the consolidated responses of the class in the form of “*a pie chart or bar graph or something like that which was visible to the whole class*” [Gloria & Hana, 7:32, line 45]. These graphs contained the data of how the whole class voted and what percentage of the class got it right or wrong. Seeing this data, as well as knowing how they answered and what the correct answer was, meant that the students could compare their own answer to how the class answered:

“*75% of the lecture said that it was True, and you voted True*” [Dowelani, 4:50, line 12].

They could also compare their own given correct answer to how the class answered:

“*[I saw that] 30% of them answered maybe no, and the no was actually wrong*”

[Gloria & Hana, 7:65, line 103].

For the students, these graphs added extra meaning to the immediate feedback about the correct answer, because they provided an opportunity for each student to see how they answered in relation to the rest of the class:

“*So the clickers also reassure you that you are not alone if you are not understanding. There are others like you in the class. Maybe not most of the class, but some people in the class are as you, who don't understand*” [Dowelani, 4:64, line 14].

Expressed in a different way, one student said: “*I could see that, oh okay this is what people think, and this is what the actual answer is. And this is wrong, definitely wrong*” [Cebile, 3:18, line 31]. Seeing the responses of the whole class allowed the students to know that they were not alone. They could “*see what people think*”, and this information allowed them to reflect on where they were in relation to the rest of the class, rather than just focus on whether they got the answer right or wrong.



## **Discussion of the findings**

Although the students liked seeing the responses immediately, very little was found in the literature on whether this helps the learning process. In some studies, delayed feedback was seen as more beneficial as it required the students to reflect on their responses before receiving feedback (Hattie & Timperley, 2007). However, providing students with instantaneous feedback keeps them more engaged and helps in creating an active environment in the classroom (Collins, 2007). Students also like seeing the responses of the other students, as this helped them to determine their own level of understanding in relation to the rest of the class, while still remaining anonymous (Draper & Brown, 2004).

In summary, feedback about the correct answer to the questions was seen as valuable and helpful to these students, firstly because the students could see the feedback immediately after they answered; secondly, the use of visual elements meant that they knew with certainty if their own answer was right or wrong; and thirdly, they could see a graph showing how the class responded, and they could use that information to compare their responses to those of the class and then reflect on their own answer to the question.

## **Category B: Feedback about their understanding of the topic**

The second category describes feedback that focuses on helping the students determine their level of understanding of the topics presented to them. This type of feedback is seen as important, as it “relates more to the relationships, cognitive processes and transfer to more difficult tasks” (Hattie & Timperley, 2007, p. 92).

The students described the process as *“the lecturer will ask a question, I get to hear the question, I get to read it and I get to see it, so I am hearing and I am seeing and it is a form of learning, and so I start to understand”* [Itumeleng, 8:84, line 125].

Once the students know the correct answers to each question, and know how they responded, the focus of the feedback can shift towards helping the students gain a deeper understanding of the topic presented. The analysis of the data showed three different aspects of the student response system that the students saw as an important part of their experience. They were:

1. Being given the answers immediately meant that the students could take immediate action if they did not understand.
2. Answering anonymously meant that they could focus on understanding the topic rather than on their peers around them.
3. Sharing their understanding with each other allowed them to learn from one another.

The first aspect of this type of feedback that the students found important was that with the use of the SRS they were given the answers during class and could therefore take immediate action if they did not understand. This was compared to their experience with regular tests: *“with the clickers you'd just be able to click and then you'd have an answer ... unlike with a test when you have to wait weeks for the answer”* [Kenneth, 9:10, line 17].

Or, as another student expressed himself:

*“I need to know and with clickers the answer is a click away”* [Bongani, 2:78, line 48].

Being given the answers in class gave the students an opportunity to test instantly whether they knew the work, so that immediate action could be taken. For some students this meant that they could ensure that they did not fall behind the class:

*“But I mean if everyone else is doing well and you're struggling then you know that you need help fast”* [Kenneth, 9:15, line 19].

For others, it helped them identify what the problem was:

*“[When I see the answers] it's much simpler because then you've just, what can I say, identified the problem for me”* [Edzai, 5:121, line 56].

And for some, *“that experience of getting it wrong in the class via [the] clicker did prompt me to go out and go outside, back to my room, back to my notes and find out some more”* [Bongani, 2:106, line 69].

The next aspect that helped them with their understanding was that the students knew that their answers were anonymous. The SRS was set up in such a way that it was not possible for the class to see the individual responses of each student, rather it was configured to only show the cumulated responses for each answer, meaning that no one in the class knew who answered the questions incorrectly. The value of anonymity for the students was that *“whatever I choose, is most likely, is not going to be of a concern to other students”* [Bongani, 2:92, line 61]. They described this as a critical aspect of using the system, as one student noted: *“I think the anonymity is like the crux of the whole thing”* [Ayanda, 1:70, line 77].

Answering anonymously meant that students were not distracted by worrying about other students knowing if they got the answer wrong, and they could therefore focus on trying to understand the topic rather than on those around them.

*“The fact that it is anonymous makes people not really concerned about others in the class” [Bongani, 2:60, line 39].*

*“If it was like obvious that clicker A is linked to one of my friends or something, then it would make it seem more competitive, more of an individual thing ... but if you're learning I think it [should be] a personal matter” [Bongani, 2:61, line 39].*

The alternative to being able to answer anonymously in class was seen by students as having to put up their hands, and there was a strong resistance to having to do this in class. The main reason given was that when answering out aloud, their attention shifts away from their understanding of the topic, and instead they become worried about what others will think of them.

The research literature shows that students prefer to answer anonymously (Collins, 2007; Fies & Marshall, 2006; Lantz, 2010), and the experience of the students in this study supports this. The view of the students was that *“if you have to stick up your hand it's more about saying your opinion and what else you can add to it ... rather than giving an answer that can help the class”* [Bongani, 2:76, line 47]. There was also a strong feeling that a student's image is important and that it is risky to answer questions aloud in class, because *“if I had to say something irrelevant, people would be like, who is this chap?”* [Bongani, 2:93, line 61].

Overall, the students' experience was that using an SRS to allow them to answer anonymously is an important aspect in creating a learning environment in the classroom.

The third and final aspect of this category was that sharing their ideas and understanding with each other allowed students to learn from one another. A student response system allows for Peer Instruction (Mazur, 1997) to be easily implemented, as the system can display what percentage of the class answered correctly. Depending on the percentage, the lecturer can then either revisit the concept, ask the students to discuss their answers with those around them, or to reveal the correct answer.

The students found peer instruction valuable because they could help others:

*“If you are sitting with someone and they don't understand why they got it wrong, you can use what you understood from the concept and tell them and try to explain it to them so that they see it the way you do” [Edzai, 5:41, line 21].*

And because the other students could also help them:

*“When we are in class you can ask the person, why you said this was the answer and then you understand. Okay, this is how I am supposed to look at it and this is how it is supposed to be like”* [Edzai, 5:51, line 25].

### **Discussion of the findings**

There are a number of studies that show that students appreciate being able to remain anonymous while using a student response system (Banks & Werner, 2008; Caldwell, 2007; Draper & Brown, 2004). Anonymity allows students to be active members of the classroom, able to participate, without having to worry about those around them and this frees them from the pressure of their peers seeing how they responded (Kay & LeSage, 2009b). A few researchers have noted that for students to share their understanding with each other is beneficial to learning (Beatty & Gerace, 2009; Mazur & Watkins, 2007), although it requires that the student can no longer remain anonymous, which provides an internal conflict for those who are not confident in their own ability.

In summary for this category, the aspects of feedback that were important to the students were the following: firstly, they felt that the system could test whether they understood the work, which allowed them to take immediate action if they did not understand; secondly, the system was anonymous, which allowed them to focus on the topic rather than on those around them; and thirdly, they could share their understanding with each other, which meant they could then learn from the experiences of their peers, thereby increasing their level of understanding of the topic.

### **Category C: Feedback about what the lecturer should do**

The next category relates to feedback to the lecturer about what she/he should do in response to seeing the overall responses.

This type of feedback was described liked this: *“the lecturer can actually get the statistics from the system immediately and then comment on that right afterwards”* [Dowelani, 4:16, line 8]. The students described their experience as realising that the lecturer would know that *“okay, this is what the answer is and this is what we're thinking”* [Edzai, 5:108, line 54], and, more importantly, the students knew that if the lecturer saw that they did not understand, then *“immediate action can be taken”* [Dowelani, 4:10, line 8].

A distinguishing characteristic of this category was that the students experienced this type of feedback even though it was not actionable by themselves, but rather was feedback to the lecturer about what to do next. Although they saw the feedback as external from themselves

and not really helpful in increasing their understanding of the concept, the feedback was seen as relevant. They took comfort in knowing that after becoming aware that they were struggling, the lecturer would then do something about it.

*“You can see okay there were twenty students who didn't get this let me explain it again. And it will sort of help students”* [Ayanda, 1:60, line 73].

They described this as *“the lecturer could explain it again”*, or *“elaborate a bit further on the matter”*. They could say *“you know what, I get that you are not getting this, that, that and that, explain to me what is the problem”* [Edzai, 5:117, line 56]. The lecturer could *“ask questions”* or *“change what to do next”*.

The students saw the student response system as a way of themselves giving feedback to the lecturer, which was possible *“without saying anything but just acting, clicking”* [Cebile, 3:38, line 63]. Their experience was that this was a way of interacting with the lecturer that overcame the disadvantage of being in a large class where there is limited lecture time and limited opportunity to talk to the lecturer:

*“When it comes to clickers ... it allows us as students to interact with the lecturer. Because at times the lecture can be full, and individual participation may be impossible given the 45 minutes we have in lectures”* [Dowelani, 4:1, line 8].

They saw this as helpful and a new way of communicating individually with the lecturer, while still being part of a large class:

*“It helped us as a class because it exposed us to a new way of interacting with the lecturer. One-on-one communication with the lecturer becomes impossible, and the clickers can be used for such things. It helps us students to be able to express what we want to say to the lecturer”* [Dowelani, 4:22, line 10].

The analysis of the data showed that there were two characteristics of the student response system that the students felt helped make this type of feedback meaningful. The first was the fact that using the clickers made it easier for them to interact with the lecturer without having to disclose who they were:

*“Clickers make people anonymous. So you no longer have to speak up and say I don't get this”* [Ayanda, 1:59, line 73].

The second aspect was that using clickers gave them a voice, and that “*you no longer need to put your hand up and say this is the answer and then have the lecturer say oh actually it's not*” [Ayanda, 1:28, line 45].

### **Discussion of the findings**

Feedback about what the lecturer should do is seen as one of the major benefits of using an SRS in the classroom (Draper & Brown, 2004; Fies & Marshall, 2006; Hoekstra, 2009). Essentially, using a student response system “changes a relatively static one-way transmission of information into a dynamic, interactive lecture guided by student input” (Cutts & Kennedy, 2005). This type of feedback is particularly useful for experienced teachers who are able to quickly modify explanations or the mode of instruction (Caldwell, 2007).

In summary, the students saw it as important for the lecturer to know if they did not understand, and that a student response system enabled them to disclose this feedback anonymously and without having to raise their hand in class and risk making a fool of themselves. A key aspect of this type of feedback is that it is directed at the lecturer, and the real value for the students came about when the lecturer responded with an appropriate action. The use of the clickers was therefore seen as an effective tool in ensuring that the lecturer could immediately know whether the class understood the concepts, or if they needed further help in understanding.

### **Category D: Feedback about the process of learning**

The fourth category of feedback relates to helping students create internal feedback routines while they are engaged with learning tasks. This type of feedback helps students to monitor and regulate their actions as they move towards achieving their learning goals (Hattie & Timperley, 2007). Such regulation also involves “self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals” (Zimmerman, 2000, p. 14).

An analysis of the data showed a number of aspects that helped mediate the learning process for the students. They were:

1. Using the clickers brought a sense of focus to the learning process.
2. Doing tasks repetitively “changes the way you think”.
3. Learning is a personal matter.
4. Learning is “like having a conversation with yourself”.
5. The system helps you know when to ask for help.

The first aspect was that using clickers helped bring a sense of focus to the learning process. Their experience was that a *“clicker lecture”* makes the class more active compared to a traditional lecture where *“it's hard to pay attention when you have to just sit and listen to whatever the lecturer has got to say”* [Edzai, 5:72, line 33].

A further challenge was that *“in a classroom or lecture theatre that's huge with lots of people, people can be talkative, they can be disruptive”*, but that the use of a student response system meant that the lecturer is able to easily *“bring people's attention to one item”* [Bongani, 2:108, line 73].

They saw the clickers as an interactive tool that help them focus their attention, and by paying attention in class they were able to learn more:

*“It does bring people's attention in the sense that now they are urged to interact with the lecturer or with the class or what's going on”* [Bongani, 2:109, line 73].

*“You pay more attention so you learn more so that is for me with the clickers”*  
[Fikile, 6:24, line 43].

The second aspect was that doing tasks repetitively *“gets your brain thinking the way you need it to”* [Ayanda, 1:47, line 65]. They felt that *“clickers helped because it stimulated different kinds of memory in your brain”*, and *“I think that your memory sort of got the concept in the classroom”* [Ayanda, 1:17, line 39].

The analysis of the data showed that although the students knew that the clickers helped them with the process of learning, they were not able to articulate what aspects of the SRS were useful to them. It is best described as an experience and that *“the experience in class helps my brain with learning, which helps me when I write”* [Cebile, 3:54, line 91].

Thirdly, the students realised that *“if you're learning I think it is a personal matter”* [Bongani, 2:52, line 35]. Their experience was that the use of clickers changed a large class experience into an individual activity between the student and the lecturer, and this was seen as very valuable.

They saw this as important because *“what I do and don't do, it should be between me and myself”* [Fikile, 6:15, line 29], and they felt that no one else should be involved in how they approached learning in the classroom. Although they saw the clickers as helpful in making learning a personal matter, they were not able to express what aspects of the system enabled them to achieve this objective.

The fourth aspect was that the students described their experience as being similar to having a conversation with themselves. Comments included: *“I’m able to evaluate and argue with myself”* [Dowelani, 4:111, line 32]; *“I just see for myself”*, and *“this conversation is between me and myself, not anyone else”* [Fikile, 6:14, line 29]; and *“I’ll just sit there and think and talk about it to myself”* [Gloria & Hana, 7:24, line 40].

This ability of students to create an internal dialogue with themselves during the activities is seen as an important aspect of learning and is fundamental in helping them become more engaged with the learning tasks (Hattie & Timperley, 2007). Not all students saw this as part of their experience, and those who did could only really describe it as a conversation that they had with themselves.

And finally, their experience was that the feedback helped them know how to move forward.

*“When you know what the problem is, it is now a matter of where to from here”*  
[Edzai, 5:123, line 56].

Their experience was that it helped them know what to prepare for exams, as *“the questions that we did with the clickers in class give us a very true sense of what we need to know for the exam and for the assignments”* [Dowelani, 4:126, line 39]. It also showed them how they needed to study because they saw that *“this is how I am supposed to study it, this is how I am supposed to look at it, this is how I am going to be asked, and this is how I should be able to answer it”* [Edzai, 5:136, line 60]. This was seen as valuable feedback because they realised that only once they knew how much they understood, could they know how to move forward towards achieving their learning goals.

### ***Discussion of the findings***

The *“sense of focus”* described by the students is referred to in the literature as being attentive or paying attention (Shute, 2008). There are a number of studies that have noted that using an SRS divides the lecture into sections, and as a result helps students pay attention and therefore brings a sense of focus to the class (Caldwell, 2007; Draper & Brown, 2004; Hoekstra, 2009).

The experience of the students in this study was that the use of the SRS assists them to know when to ask for help. Hattie and Timperley (2007) found that students need strategies for detecting errors, and that giving themselves feedback could be one strategy that leads to them seeking help. An alternative to seeking help is giving up, and it is therefore important that the lecturer is aware of this and provides alternative support for those students who need it (Shute, 2008).



In summary, the students saw clickers as being able to provide feedback about the process of learning. Firstly, they felt that clickers helped bring a sense of focus to the learning process; secondly, it got their brain thinking the way it should; thirdly, it helped learning to be a personal matter; fourthly, it created an internal dialogue about the learning process; and lastly, it helped them know how to move forward.

### **Category E: Self-directed feedback the students gave themselves**

The final category deals with self-directed feedback that the students gave themselves during the process of using the clickers. Feedback in the form of praise (positive) or criticism (negative) is seen as personal feedback that the students use to evaluate their actions against the learning goals. Such feedback contains little task-related information but rather comprises of self-directed feedback based on their perception of the value of their personal performance of the tasks.

The students described this type of feedback as either a positive or a negative evaluation of themselves, depending on the circumstances. The feedback was not linked to any specific questions or learning tasks, but was more about the feelings within themselves that surfaced when using the clickers.

The positive aspect was that the students felt a sense of self-worth in being able to contribute to the class while using the clickers. When they saw the graph of responses and knew that their answer was included in those responses, they felt that *“it brings a new level of learning, because I feel that I'm contributing towards this course”* [Dowelani, 4:29, line 10].

On the other hand, there were times when their lack of knowledge contributed to them feeling ashamed and inadequate because *“of the fact that I never had the chance to do this before”* [Edzai, 5:115, line 56]. For some, their past experience at school had led to the situation where they did not have the knowledge that others did, and this meant that the experience was then hard for them to deal with:

*“If it looks like something that's obvious and everyone else gets it right and you get it wrong. It does sort of bring an element of shame”* [Kenneth, 9:18, line 29].

Some put this down to increased expectations or having high hopes about their future at the university:

*“I came to university with high expectations and I expect the best of myself”*  
[Gloria, 7:69, line 108].

*“You do well and you immediately have these high hopes”* [Hana, 7:74, line 110].

Overall, the students gave themselves positive feedback about their performance of the tasks and felt that answering correctly *“encourages you in a way”*, and that because *“our opinions are recorded ... you feel that you are contributing”* [Dowelani, 4:23, line 10].

### **Discussion of the findings**

An important element of this category of feedback to be noted is that “the effects are too diluted, too often uninformative about performing the task, and too influenced by students’ self-concept to be effective, and the information has too little value to result in learning gains” (Hattie & Timperley, 2007, p. 96). What is important though is for the lecturer to recognise that these feelings exist, and to help the students to focus on the other types of feedback that are more directed towards the learning tasks.

## **4.5 Comparison of the Categories of Description**

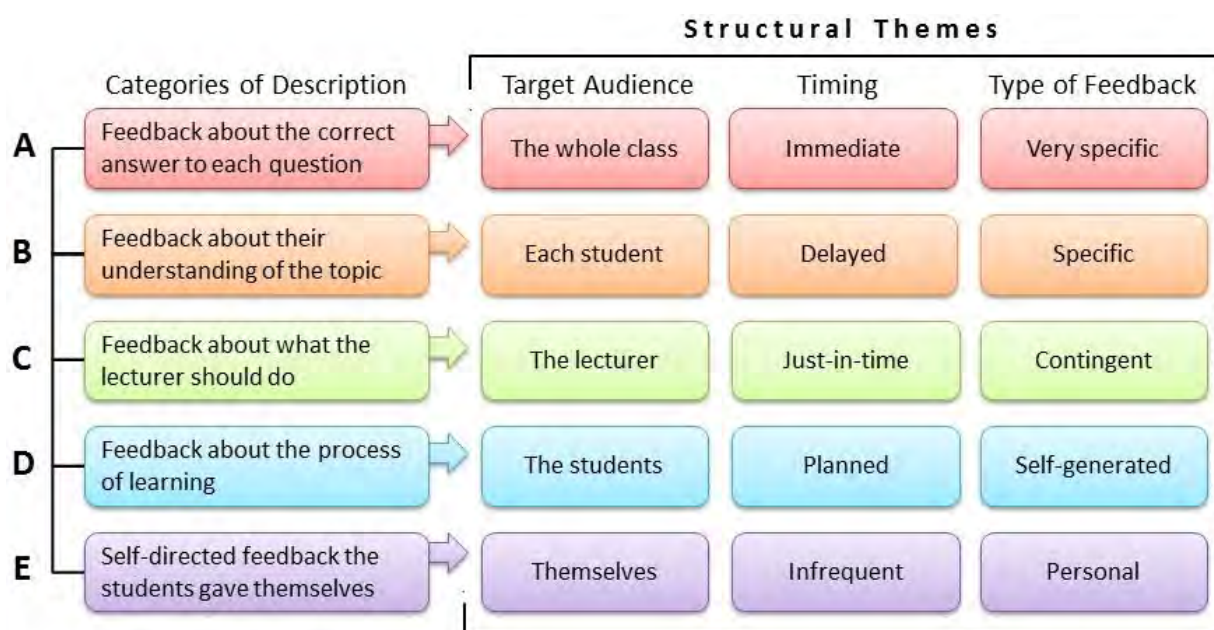
Each of these categories was seen as being distinctly different from each other, and each one addressed a different type of feedback. The overall analysis of the data revealed that the use of a student response system was seen by the students as an effective tool in providing formative feedback to a large class, although it was clear from the findings that some types of feedback were more effective than others. Feedback that was more specific and provided by the system (Categories A and B) was seen as far more important and effective than other types where the feedback was more of a general nature and was provided by the students to themselves (Categories D and E). Feedback to the lecturer about what the lecturer should do (Category C) was described as useful, but only because the lecturer would then know that the students did not understand and then the lecturer could do something about it. Knowing that the lecturer could take appropriate action when they did not understand made this type of feedback important to the students.

## **4.6 Structural Relationships**

This section moves away from describing the categories and focuses on the structural relationships or themes that make up the phenomenographic outcome space.

The categories of description presented in the previous section represent the qualitatively different ways students conceive of feedback. The relationships between these categories determine the structure of the experience, and this structure is characterised by themes that serve to both link and differentiate the categories (Akerlind, 2005). These themes are presented

as the structural relationships of the outcome space and are summarised in Figure 4.3 and described below.



**Figure 4.3 – The structural relationships of the outcome space**

#### **4.6.1 Target audience**

The first structural theme relates to the target audience of the feedback. In Category A, the feedback about the correct answer was directed at the whole class, whereas in Category B the feedback was aimed at ensuring that each student understood the topic presented. Feedback about what the lecturer should do was meant for the lecturer, while the target audience for Category D and Category E was the students themselves.

#### **4.6.2 Timing of the feedback**

Timing is an important aspect of providing feedback and often requires different timeframes in order to be effective. In Category A, the feedback to the students was immediate in form of the correct answer being displayed instantly after they have answered. In Category B, delayed feedback was preferred in order to provide an opportunity for reflection before the feedback is given. Category C relates to feedback to the lecturer, and this needs to be provided “just-in-time” for the lecturer to take action if it is clear that the students do not understand. The timing for Category D was seen as planned feedback, and relates to self-generated thoughts and actions that are planned to achieve the students’ learning goals. The feedback described in Category E occurs infrequently and was seen as personal feedback that the students provide themselves about the value of their performance of the learning tasks.

#### **4.6.3 Type of feedback given**

In Category A and Category B, the feedback was seen as being specific. In Category C, the feedback to the lecturer was directive. In Category D, the feedback was self-generated by the students themselves, and although the feedback in Category E was also self-generated, it was seen as more personal than that of Category D.

### **4.7 Summary**

This study used a phenomenographic approach to analyse the student interview transcripts that formed the empirical data for this research. The findings were presented firstly as a summary of the outcome space, and secondly in form of the individual categories of description. Each of the five categories was then described in detail, using extracts from the student interviews to illustrate the critical aspects of each category. The chapter concluded with a short description of the structural themes that serve to link the categories of description.

## Chapter 5 – Discussion

This chapter relates the findings presented in Chapter 4 to Laurillard's Conversational Framework discussed in Chapter 2. The findings are used to show which of the learning activities described in the framework are supported by a student response system and which ones are not supported. This information is then used to develop a diagrammatic representation of the interpretation of Laurillard's Conversational Framework for a student response system.

### 5.1 Relating the Findings to the Conversational Framework

Mapping the five categories of description onto Laurillard's Conversational Framework shows how each of the categories relates to the different activities that are needed in order to complete the learning process.

The experience of the students described in Category A, was that a student response system is good at providing feedback about the correct answer. This relates to the interactive level on the Conversational Framework where the teacher can set a task goal that requires an action from the students.

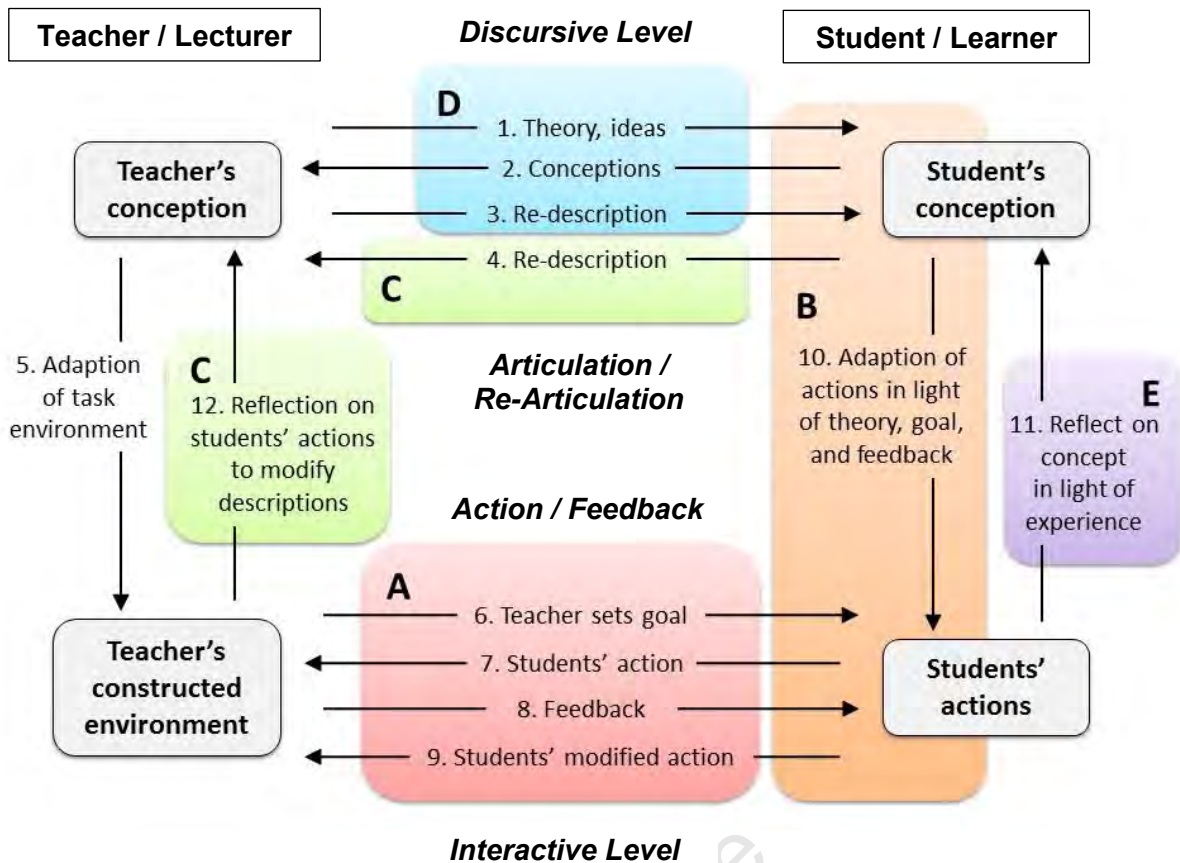
Category B describes acquiring more or different information and being able to distinguish correct answers from incorrect answers. This allows the student to adapt their actions in light of theory, goals and feedback.

Category C describes feedback to the lecturer about the level of understanding of the class. This information allows for the teacher to reflect on the students' actions and the teacher can then modify their description of the topic accordingly.

Category D was about feedback about the learning process and this can be mapped to the discursive level on the Conversational Framework.

The final category E describes feedback that the students gave themselves after reflecting on their actions in light of their experience.

This information can be used to relate the categories of description to the activities of the Conversational Framework and can be diagrammatical depicted in Figure 5.1 as follows:



**Figure 5.1 – Relating the findings to Laurillard's Conversational Framework**

### 5.1.1 Interactive level

The findings showed that feedback provided at this level was seen by the students as important as it kept them more engaged and helped to create an active environment in the classroom. The SRS helped students engage with the topic, as well as with the lecturer and with their peers in the classroom. It was a useful tool in facilitating the interaction between the students' actions and the teacher's constructed environment.

### 5.1.2 Discursive level

The TurningPoint software used in this study was able to provide a number of different reports showing how the students answered each question, and this was available after the lecture was concluded. In this way the students are able to provide their theoretical conception to the teacher of the concepts presented, allowing for the SRS to operate on the discursive level. Activities 1, 2 and 3 on the other hand, are related to Category D and the experience of the students in this study was that these activities are not well support by a student response system. Their experience was that an SRS works better at the interactive level rather than at the discursive level.

### 5.1.3 Reflection and adaption

Category C relates to reflection by the teacher on the actions of the students, and category E relates to reflection by the students on their actions. The findings in this study show that reflection by the students (activity 11) related more to reflection on their performance in the overall process, when it should rather have been a reflection on their current actions (activity 12). The framework requires the students to reflect on their actions in light of their experience as this then enables them to modify their actions accordingly. The lack of reflection limited the ability of the students to respond accordingly and reduced the effectiveness of the formative feedback. The practical implication is that the process of reflection and adaption needs to be prompted by the teacher as these activities are not an inherent function of using a SRS.

## 5.2 Learning Activities for a Student Response System

The diagram in Figure 5.1 shows how each of the categories corresponds to one or more of the Conversational Framework learning activities. However, only some of the activities are supported by the use of a student response system.

- A student response system works well at the interactive level and this is covered by activities 6, 7, 8 and 9.
- By using Peer Instruction in the classroom, the students can adapt their actions after receiving feedback from the SRS and after discussion with their peers. This is covered in activity 10.
- Activity 5 relates to the teacher adapting the constructed environment, and this is normally done by setting up the system before the students arrive in class.

There are a number of activities that are not supported by the use of an SRS. These are:

- The discursive level activities 1, 2 and 3.
- Activity 11 where the student reflects on their interaction.
- Activity 12 where the teacher reflects on student interaction to begin new dialogue.

Table 5.1 shows a list of the learning activities that are supported by a student response system.

Conversational Framework Activities		SRS
1.	Teacher presents theory and ideas	○
2.	Student expresses understanding through comments or questions	○
3.	Teacher re-describes the conception based on the understanding	○

Conversational Framework Activities		SRS
4.	Student re-describes their conception of the topic as output	✓
5.	Teacher adapts constructed environment	✓
6.	Teacher sets task goal	✓
7.	Student acts to undertake task	✓
8.	Student receives feedback on action	✓
9.	Student generates new action to undertake task	✓
10.	Student adapts action in the light of conceptual knowledge and feedback	✓
11.	Student reflects on interaction using conceptual knowledge	○
12.	Teacher reflects on student interaction to begin new dialogue	○

***Table 5.1 – Learning activities that are supported by a student response system***

The supported activities can be described as follows:

	Conversational Framework Activities	Student Response System Activities
1.	Teacher can describe conception	-
2.	Student can describe conception	-
3.	Teacher can re-describe in light of students' conception or action	-
4.	Student can re-describe in light of teachers' re-description or students' action	Student outputs are extracted from the response system session reports
5.	Teacher can adapt constructed environment in light of students' description or action	Teacher hands out clickers and tests receiver and software
6.	Teacher can set task goal	Teacher shows multiple choice question
7.	Student can act to achieve task goal	Student answers using clicker device
8.	Teacher can set up world to give intrinsic feedback on actions	Teacher shows histogram Teacher shows correct answer
9.	Student can modify action in light of feedback on action	Student answers again using clicker device in light of feedback
10.	Student can adapt action in the light of description or students' re-description	Student can answer the question again after discussion with their peers
11.	Student can reflect on interaction to modify re-description	-
12.	Teacher can reflect on students' action to modify re-description	-

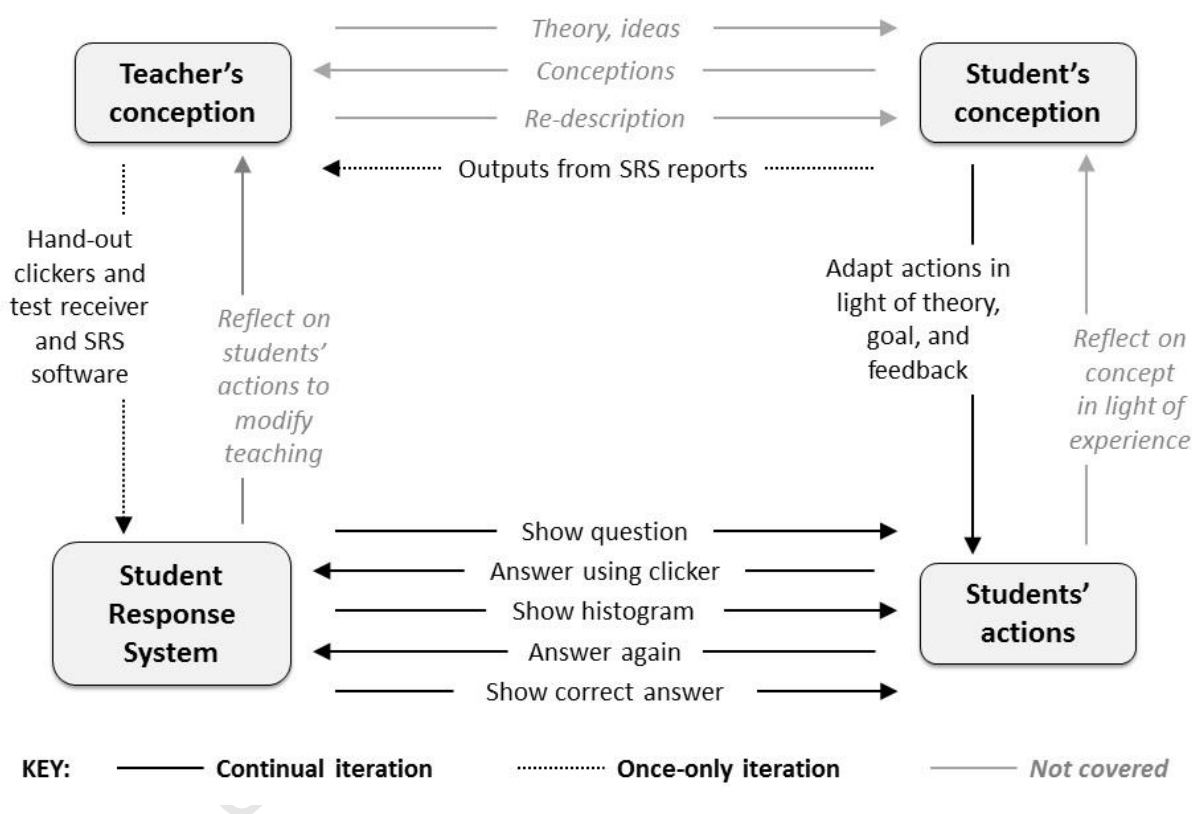
***Table 5.2 – Description of student response system learning activities***



## 5.3 Conversational Framework for a SRS

The activities described in Table 5.2 can be used to develop a diagrammatic representation of the interpretation of Laurillard's Conversational Framework for a student response system. This diagram is useful in interpreting how a student response system should be used in the classroom.

In the diagram below, the supported activities are represented in black and the unsupported activities in grey. The solid arrows represent a continual iteration, while the dotted arrows denote activities that occur only once.



**Figure 5.2 – Interpretation of the Conversational Framework for an SRS**

Figure 5.2 shows coverage of the Conversational Framework that is achieved by the use of a student response system in the classroom. The interactive level is well covered as well as the adaption activities, and these activities are able to provide feedback to both the student and to the teacher.

The diagram shows that the discursive level is not well covered and therefore these activities would take place outside of an SRS. Although the students can adapt their actions by answering the question again, this process should be supported by reflecting on the actions which unfortunately is also not covered by the use of an SRS.

## 5.4 Summary

The findings indicate that a student response system is well suited to be used for activities at the interactive level, and is not necessarily seen as an effective tool in supporting the discursive or theoretical learning activities in the classroom. Another important finding was that a student response system is not seen as a tool that can be used to provide effective support for the reflection activities of the Conversational Framework, and as a result this limits the ability of the students to adapt their actions.

A further finding was that although an SRS is able to provide information for the teacher that can be used to quickly modify explanations or the mode of instruction, using this information does rely on the ability of the teacher in order to be effective.

A student response system works best when used to facilitate the interaction between the students' actions and the teacher's constructed environment, and it is important that this process be guided by a pedagogical framework like Laurillard's Conversational Framework. The findings of this study were used to identify the activities that are supported by the use of a student response system, and this information was then used to provide an interpretation of Laurillard's Conversational Framework for an SRS.

## Chapter 6 – Summary and Recommendations

This chapter reviews the problem statement and methodology and then presents a brief summary of the findings of the research. It then discusses the results of the study as well as the limitations and then makes recommendations for future research. The chapter ends with concluding remarks regarding the overall study.

### 6.1 Problem Statement and Methodology

The problem addressed in this study was to determine if a student response system can assist in meeting the needs of a changing educational environment by providing formative feedback to students in large classes. The purpose of the study was to collect empirical data that could be used to determine if the use of an SRS is an effective tool in supporting the learning process in the classroom.

The research question for this study asked: “What are the students’ conceptions of the use of a student response system to provide formative feedback in a large class?”. The study used Laurillard’s Conversational Framework to guide the pedagogical use of the SRS, while the data was analysed using a phenomenographic approach. Taking a phenomenographic approach to collect the data helped identify the different ways that the students experienced, conceptualised and perceived the phenomenon of using clickers to provide formative feedback in the classroom. The focus was on describing and understanding the range of experiences of the whole group rather than on describing and understanding individual experiences; and the data was collected using semi-structured interviews that were recorded and transcribed verbatim.

The outcome of the phenomenographic analysis was presented as five different categories of description and three structural themes, referred to as the ‘outcome space’.

### 6.2 Summary of the Findings

#### 6.2.1 *Categories of description*

There were five categories of description that emerged for the data analysis phase.

The first category focused on the experience of the students when they received feedback about the correct answer to each question that was asked. Providing students with immediate feedback keeps them more engaged and helps in creating an active environment in the classroom (Collins, 2007). The students found this very helpful and this was seen as an important aspect of using a student response system in the classroom.

The next category of feedback focused on helping students to determine their level of understanding of the topics that were presented. Using an SRS allows students to participate anonymously and this means that they can focus on understanding the topic rather than on their peers around them. The students also were able to share their understanding with each other and research has shown that this is beneficial to learning confirming the findings of Beatty & Gerace (2009) and Mazur & Watkins (2007).

The third category related to feedback about what the lecturer should do in response to seeing the overall responses of the class. Feedback about what the lecturer should do, is seen as one of the major benefits of using an SRS in the classroom (Draper & Brown, 2004; Fies & Marshall, 2006; Hoekstra, 2009). This type of feedback allows the teacher to quickly modify explanations or the mode of instruction and creates a dynamic environment in the classroom.

The fourth category of feedback helped the students understand more about the learning process in order to help them monitor their actions toward the learning goal. Clickers helped bring a sense of focus to the learning process and this was seen as helpful in getting their brain to think the way it should.

The final category covered self-directed feedback that the students gave themselves during the process of using the clickers. Feedback that does not lead to action has little value for the students and often does not result in learning gains (Hattie & Timperley, 2007). It is important for teachers to be aware of this and to help students focus on other types of feedback that are more directed towards the learning tasks.

### **6.2.2 Structural themes**

There were three structural themes that linked the categories of description. These were:

1. The target audience.
2. Timing of the feedback.
3. Type of feedback given.

These themes played an important part in the findings, as they showed that although the categories of description were different, there were common elements across all categories. The first element, i.e. the target audience, is important, as feedback needs to take the audience into account before it can be seen to be effective. Equally important is the second element, that of timing of the feedback. The findings showed that there are times when feedback needs to be given immediately, at other times it needs to be delayed, and sometimes it is better not given at

all. The third element, the type of feedback, showed that although feedback is common across the categories the type of feedback will be different depending on the circumstance.

### **6.3 Discussion of the Findings**

The results of this study show that a student response system is well suited to supporting interactive learning activities in the classroom. The use of an SRS allows the lecturer to divide the lecture into different parts, and a number of studies that have noted that this helps students to pay attention, resulting in an increased sense of focus in the class (Caldwell, 2007; Draper & Brown, 2004; Johnson & Meckelborg, 2009). A key element of the system is that it allows the students to participate anonymously, and this means that they can focus on understanding the topic rather than on their peers around them.

Using Laurillard's Conversational Framework (2002) to analyse the findings revealed that not all of the learning activities are supported by the use of an SRS. Mapping the findings onto the Conversational Framework showed that a student response system works well at the interactive level and can also support the activities where the student can adapt their actions after receiving feedback. Although the students reported receiving feedback at the discursive level, these activities were not well covered by the use of a student response system and the discursive activities rely on the ability of the teacher in order to be effective.

The overall findings of this study are that using a student response system encourages active learning; allows lecturers to get precise real-time feedback; is good at anonymous data collection; and is an effective tool in providing formative feedback to students in large classes.

### **6.4 Limitations**

There are several limitations of this study that need to be considered.

Firstly, the data was gathered from students who were all enrolled in the same course at the same institution. As a result, the findings cannot necessarily be generalised to cover other students at other universities, or even the same students doing a different course.

The second limitation is that the focus of a phenomenographic study is on the experience of the students, and the experience of the students in this study could be possibly have been influenced by many different factors over the course of the semester. It is therefore quite possible that the same study, carried out under similar circumstances, would produce different results.

## **6.5 Recommendations**

### **6.5.1 Recommendations for the institution**

A student response system is a useful tool in providing formative feedback in the classroom, but the technology needs to follow a pedagogical framework in order to be effective. The findings of this study have shown that the use of an SRS works well at the interactive level, but does not necessarily support activities at the discursive or theoretical level. The implication is that it is important to first understand the needs of the teachers and learners, and only then to determine how technology can meet these needs. A student response system will only be effective in the classroom if the learning objectives are clearly defined and are at an appropriate level for the technology. The pedagogy must come before the technology.

### **6.5.2 Recommendations for future research**

The literature shows that there are some studies that see a student response system as pedagogy and treat it as such, when in fact it is only a tool that can be used in different ways to support an existing pedagogical approach. In this study, Laurillard's Conversational Framework was used as the pedagogical framework as it embedded feedback as a dialogue between teacher and student and it would be useful to see future studies further develop this approach. Alternatively, there are other frameworks that could be adapted for use with a student response system namely "The ConcepTest Peer Instruction" (Lasry, 2008) and "Technology-Enhanced Formative Assessment" (Beatty, 2007) and the recommendation for further studies is that these frameworks be pursued in order to develop a robust pedagogy that can be used to support the use of a student response system in the classroom.

## **6.6 Concluding Remarks**

This study set out to gain a better understanding of students' conception of the use of a student response system to provide formative feedback a large university class. The approach taken was to deliver the feedback using a proven theoretical framework, and then to gather the experiences of the students in order to understand their perception of the experience.

The results indicate that feedback is important to both teachers and students. Feedback creates connections by helping students understand more about learning through assisting them to focus on their learning goals. It helps students to know where they are and where they are going, and prompts them to think about how to close the gap.

The key to delivering effective feedback is to ensure that the pedagogy is emphasised above the technology, and not the other way around. It is important to first understand the needs of the teachers and learners, and to then determine what the technology can do to support the learning environment.

After all, “technology works best when it has to meet a challenge, rather than being merely a solution looking for a problem” (Laurillard, 2008, p. 14).

University of Cape Town

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# Appendices

## Appendix A – Clicker Lesson Plan Template

Activity	Description	Time Allocation
Create	Set up the computer and hand out the clickers	15 minutes
Open	Present an introduction to the lesson	5 minutes
Explore	Lecture and 1 <sup>st</sup> clicker session	15 minutes
Explore	Lecture and 2 <sup>nd</sup> clicker session	15 minutes
Close	Present a brief summary of the lesson	5 minutes
Collect	Collect the clickers as the students leave class	5 minutes
Connect	Connect with students who want individual attention	5 minutes
End	Save the session and shut down the computer	5 minutes

Time	Activity	Description
10:50	Create	Set up the computer and start the TurningPoint software
10:55	Create	Hand out the clickers to students as they arrive
11:00	Create	Students answer a check-in question as latecomers arrive
11:05	Open	Present an introduction to the lesson
11:10	Explore	Brief lecture – Topic 1
11:15	Explore	Brief lecture – Topic 1
11:20	Explore	Clicker questions – Topic 1
11:25	Explore	Brief lecture – Topic 2
11:30	Explore	Brief lecture – Topic 2
11:35	Explore	Clicker questions – Topic 2
11:40	Close	Present a brief summary of the lesson
11:45	Collect	Collect the clickers as the students leave class
11:50	Connect	Connect with students who want individual attention
11:55	End	Save the TurningPoint session and shut down the computer

## Appendix B – Interview Request Letter



Convenor & Lecturer: INF1002H

**Ian Barbour**

Room 3.03.2  
Leslie Commerce Building  
Upper Campus, University of Cape Town  
Tel: +27 (0) 21 650-4387

E-mail: [ian.barbour@uct.ac.za](mailto:ian.barbour@uct.ac.za)  
Internet: [www.uct.ac.za](http://www.uct.ac.za)

### To the students of INF1002H

As partial fulfilment towards a Masters degree (ICT in Education) I am researching the use of clickers in large classes and am particularly interested in understanding more about how students experience the use of clickers in the classroom.

The title of my research is: **Using a student response system to provide formative feedback in large classes: A phenomenographic study at the University of Cape Town.**

In order to achieve my objective, I am wanting to interview students who have used clickers in lectures and who are willing to talk to me about their experience. Was it useful to you? Did you enjoy using them? Did it help you in your studies? Anything that will help me understand your experience.

Each interview will be recorded, and the transcript will become part of the research presented to the University. All names of individuals will be anonymised using pseudonyms in the transcribed documents. The interview will take no longer than 30 minutes and can be done individually or with one or two other students if you prefer.

Your participation in this study will remain confidential, and all information gathered about any individual will be treated as strictly confidential. This study is conducted for academic purposes only. If the research findings prove to be useful to the broader community, the results will possibly be presented in a journal or at a conference.

Participation is voluntary, and you may withdraw from the process at any time.

The interviews will be conducted from Friday 3<sup>rd</sup> June to Friday 10<sup>th</sup> June 2011 at UCT.

**If you are willing to be interviewed, then please let me know** by email or by writing your name on the sheet provided. Please could you also indicate a date and time that suits you.

Thank you for your time and cooperation, your participation is greatly appreciated.


### **Ian Barbour (Researcher)**

Mobile: 082 824-2172  
Email: [ian.barbour@uct.ac.za](mailto:ian.barbour@uct.ac.za)  
Room 3.03.2 Leslie Commerce Building  
University of Cape Town  
Phone: 021 650-4387

### **Associate Professor Cheryl Hodgkinson-Williams (Supervisor)**

Email: [cheryl.hodgkinson-williams@uct.ac.za](mailto:cheryl.hodgkinson-williams@uct.ac.za)  
Phone: 021 650-5030

## Appendix C – Research Consent Form

 <div>             University of Cape Town              Faculty of Humanities  <b>Research Consent Form</b> </div>	
<b>Title of research project:</b>	Using a student response system to provide formative feedback in large classes: A phenomenographic study at the University of Cape Town.
<b>Name of principal researcher:</b>	Ian Barbour
<b>Department address:</b>	School of Education, University of Cape Town Private Bag X3, Rondebosch 7701 Republic of South Africa
<b>Telephone:</b>	021 650-2769
<b>Email:</b>	hum-education@uct.ac.za
<b>Name of participant:</b>	
<b>Nature of the research:</b>	A phenomenographic qualitative study, using semi-structured interviews to gather the data.
<b>Participant's involvement ~</b>	
<b>What's involved:</b>	A 30 minute interview to talk about your experience of using clickers in the INF1002H lectures.
<b>Risks:</b>	None
<b>Benefits:</b>	None
<b>Costs:</b>	None
<b>Payment:</b>	None
<ul style="list-style-type: none"> <li>• I agree to participate in this research project.</li> <li>• I have read this consent form and the information it contains and had the opportunity to ask questions about them.</li> <li>• I agree to my responses being used for education and research, on condition that my privacy is respected, subject to the following: <ul style="list-style-type: none"> <li>○ I understand that <b>my personal details will be used in aggregate form only</b>, so that I will not be personally identifiable.</li> </ul> </li> <li>• I understand that I am under no obligation to take part in this project.</li> <li>• I understand I have the right to withdraw from this project at any stage.</li> </ul>	
<b>Signature of participant:</b>	
<b>Name of participant:</b>	
<b>Signature of principal researcher:</b>	
<b>Name of principal researcher:</b>	Ian Barbour
<b>Date:</b>	



## **Appendix D – Interview Protocol and Contextual Question**

### ***Interview introduction***

I am doing a study on clickers as part of my Master's degree, and I am talking to students that have used them in the classroom. I do not have a set of pre-determined questions to ask you, as the approach I'm taking is having a conversation to talk about your experience of clickers in the classroom. And when I say 'clickers', I do not mean only the little hand-held device – I am interested in the whole experience of you being shown a question, using the clicker to having to answer it, and then seeing the results etc. Does that make sense to you?

Some formalities – I'm recording this conversation, are you okay with that?

Afterwards I will get someone to type up what we discuss, and the transcript will then become part of the research. Your participation in this study is confidential, and any names including your own will be replaced with pseudonyms. And at any time you are free to withdraw from the process if you want to.

Are you happy with that?

Any concerns?

Okay, let's start.

### ***Contextual question***

When the clickers were first handed out in class, what did you think?

### ***Types of probing questions to ask:***

- How did you feel? (or What did you like about that?)
- What did you think?
- What did you do?
- What did you say?

### ***Examples of questions to ask:***

- When the clickers were being handed out, what was that like?
- Just before you were about to answer a question, what did you think?
- When you were asked a question that was difficult, what did you do?
- When asked to discuss your answer with someone else, what did you say?

### ***Action and Effect***

Always switch between a question that asks about action and a question that asks about the effect of the action. Only asking action questions leads to "I did A, then I did B, then I did C" sequence, which is very light in content. "I did this and the effect was X, so I said Y and the effect was Z" is a richer dialogue of the experience and leads to a "thickening" of the experience.

## Appendix E – Interview Transcript for Dowelani

### *Start of interview with “Dowelani”*

#### *Recording – Part 1*

[00:00] INTERVIEWER: Okay I’m going to read just to start just so you know what it is. Okay? I’m doing a study on clickers as part of my Masters so I’m talking to students just to understand their experience of clickers. And it will be recorded and then the transcript and will be written and it will become part of the research. So anytime you are free to withdraw and your participation is confidential. Okay? That fine?

DOWELANI: Fine.

[00:35] INTERVIEWER: All I’m really trying to understand is how students experienced clickers in the classroom. I don’t have a list of questions. I don’t have a predefined list of things that I want to ask. I’m just trying to understand how you experienced the clickers. So I thought to start if you would just tell me a bit about your background. Are you happy with computers? Do you use computers? What’s your experience with that?

DOWELANI: Computers, well we have one at home. Our school had about 20 computers for the whole school and basically my experience with computers is just typing and printing, no advanced Excel manipulation, nothing like that. Just basic typing and printing, and making a report, filing that sort of thing on the computer. And basically my literacy is just basic when it comes to computers. I know I can do what I have to do, that’s about it. When I came to UCT I had to know how to use a computer and fortunately I have one at home, and it wasn’t so much of an adjustment. Of course I had things that I had to learn. Things that I needed to know, how to do for me to succeed in my university career, which I’ve learnt. The I.S. course helped with a lot of stuff including Excel. Because all I knew how to do was to type, and to print, and to do all the basic stuff. When it comes to Excel it was a bit advanced so the course helped me to just sort of to do that.

[02:40] INTERVIEWER: So now when it comes to clickers?

DOWELANI: When it comes to clickers ... it allows us as students to interact with the lecturer. Because at times the lecture can be full, and individual participation may be impossible given the 45 minutes we have in lectures. So the clickers allow us students to actually have our opinion and to vote sort of, so that the lecturer instantly can know the feeling in the class. In lectures you are able to assess, as a lecturer you are able to assess, the level of understanding amongst the students instantaneously without having to test them formally. So it just gives an option to actually test whether the students understand the work immediately so that immediate action can be taken I guess. So it’s very helpful. It’s fun for us students, because we also feel like we are contributing towards something and our opinions and our answers and our feedback is valuable. So the lecturer can actually get the statistics from the system immediately and to comment on that right afterwards. So it’s very convenient.

[04:00] INTERVIEWER: It’s convenient for the lecturer but do you find that for yourself that it was convenient, as opposed to just helping the lecturer. Did it help you?

DOWELANI: It helped us as a class because we ... it exposed us to a new way of interacting with the lecturer. One-on-one communication with the lecturer becomes impossible and the clickers can be used for such things. It helps us students to be able to express what we want to say effectively. Our opinions are recorded and thus you feel that you are contributing and you feel a sense of self-worth. Because whatever results come up, your input has been part of that. You are not side-lined by anything because clickers record what you think. And as a student you also feel that you are involved in this lecture. And in the course you are actually participating. And it brings a new level of learning, because you also feel that I’m contributing towards this course and what I have to say is being considered and is being recorded. So it’s not the loudest person in the class who gets to put their point across. You know the quietest person in class can actually get their point across in as much effective way as the other person does. On a personal level, it does do something like that.

***Interview with “Dowelani” continued:***

DOWELANI: Of course it has benefits for the lecturer, but for the students as well they feel that sense of involvement in their course. And the clickers are able to do that.

[05:51] INTERVIEWER: When do you feel that. That’s very articulate what you’ve just said. When do you feel that? Do you feel that in the lecture, in the course? Or do you feel that now that we’re talking about it?

DOWELANI: You feel that in the course, in the lectures. Because you might ask a question and it’s very easy for people to raise hands, but you don’t get everyone’s input. So when you get the clickers, you feel okay fine, part of the answer I contributed to. And you can also assess yourself immediately, that am I wrong or am I right. Or you assess yourself, your level of understanding, with something in the course. So you do feel that, okay fine, that data that is showing the number of people that voted with Yes or No, A B C or D – I contributed. I contributed to that answer. And also in class as well, you feel that you belong. I don’t know how to put it, you feel that you belong to a lecture, to a group of people. But at the same time your input can be individualised taking into account the accumulative response. So your response is valuable. Otherwise if you didn’t vote, it wouldn’t be. The stats wouldn’t be as they were. So you do feel that. That if there was a 75%, 75% of the lecture said that it was True, and you voted True, you also feel that I contributed to that 75%. And it runs across to all the lectures where we use clickers

[07:32] INTERVIEWER: And then what happens if you didn’t vote True? If you weren’t part of that 75%? Does that make you feel any different?

DOWELANI: It doesn’t. In a sense that you ... there’s also a sense of measuring where you are. When you voted wrong you immediately, you immediately know that okay fine, I was wrong. And you get that immediate response from the clickers. And you also feel that you are part of the class, because not everyone in the class understands, so you also feel that you’re not alone. Usually when you get your results maybe, and you update your test marks, and you think, okay fine I failed in a particular test. What about the others? Am I the only one? But you know when you feel, okay I’m not alone in the class, that doesn’t understand the work, so I can be more free to go ask for help. So the clickers also reassure you that you are not alone if you are not understanding. There are others like you in the class. Maybe not most of the class, but some people in the class are as you, who don’t understand. So the clickers, they may be technological but they do bring a sense of accomplishment if you know your work. In a sense that you get an immediate response from it and you get conviction, when your answer is right or wrong, immediately. So it does have that personal effect on people.

[09:08] INTERVIEWER: And is it useful for you to feel that you’re not alone in the class?

DOWELANI: It’s very useful. Because sometimes you feel like you are drowning in University. You feel like you are the only person who is struggling, while the clickers might prove that you are really not. And since the statistics may be confidential, the rest of the class might not know who voted A B or C. So that way you get to console yourself. Because if you look at people on campus they look on top of their game, everything under control. And when you’re feeling that you’re not coping, you feel that you not succeeding in your course, you feel that you don’t have enough time to do a lot of stuff, the clickers give other people away. Because it allows you to be honest, because it’s confidential. The clickers allow you to be honest. And thus when you get the statistics, you can actually console yourself and say okay fine I’m not alone and there are other people who are struggling as me, if not worse. So they do have that kind of effect on people

[10:26] INTERVIEWER: Now looking at confidentiality. If the lecturer knew who you were. Would it make a difference?

DOWELANI: It wouldn’t, because there’s a level of trust that we put in our lecturers. Because in the class they are the most senior person in the class, regardless of age, because they are your lecturer. And by virtue of being your lecturer they demand a certain trust, which they have. And we know based on the University’s motto, and how the lecturers’ and the relationships between lecturers and students, we know that the lecturers are the kind of people you can trust. Go to for help.

***Interview with “Dowelani” continued:***

DOWELANI: And they will if they can. So even if your lecturer knew, if your lecturer knew that you had problems, it's actually for the better because they know where to help you. Instead of a one-on-one consultation. It also saves time, because if everyone of us could go to the lecturer and say listen I have a problem, it would take a lot of time before they actually get to study the problem if a lot of people come one-by-one. But the clickers also allow you the time to instantaneously get the feeling of the course. So as a lecturer they can know what to do next. So it wouldn't make a difference. It actually makes it better that the lecturer knows that so-and-so is struggling and the necessary steps can be taken to help that person.

[12:00] INTERVIEWER: So if a question comes up and you get it wrong. Do you then share that with your fellow people, your fellow classmates? Or is that not something that you would do?

DOWELANI: It doesn't come naturally to talk to the other person if you got it wrong. But I wouldn't say that I wouldn't tell the other person. It depends really on your level of confidence. It might not be easy to talk to the other person, and naturally I don't think you do tell the other person if you got it wrong. Or do you even tell the person you got it right?

[12:41] INTERVIEWER: Well that would be another question, would you tell?

DOWELANI: Not necessarily, no. Because clickers allow you that confidentiality. Whether I'm right or wrong. the clickers know.

[12:54] INTERVIEWER: And I suppose what you're saying is that sharing it with somebody else you're breaking that confidentiality. Am I right?

DOWELANI: Yes. That little thing in your hand is a powerful tool, in that you can express yourself without anyone knowing it. Even if they are sitting right next to you. It's just a press push of a button. So it comes in very handy.

[13:18] INTERVIEWER: I asked about your computer experience. Do you feel that for the clickers, you need to have experience to use them? Or is it easy to use? Or your experience was it's just so easy you have a cell-phone it's the same?

DOWELANI: It's very easy to use.

[13:36] INTERVIEWER: Or is it quite difficult to try and understand what needs to be done, and when you do it, and when you push the button?

DOWELANI: No no. It's literally very simple. You just have buttons from 1 to 9 and zero and with alphabets. And if you vote A you press A. It's very simple. It can't be simpler. It really can't be simpler.

[14:00] INTERVIEWER: So it doesn't get in the way of trying to achieve what the purpose of the question is?

DOWELANI: No it doesn't. Even the person who has never used a cell-phone I think would not find difficulties with clickers. And especially today there are a lot of people, most people have cell-phones, it was extremely simple. It's in fact mundane if you are looking at it. You look, this thing, can it do anything? But in fact it's really helpful.

[14:33] INTERVIEWER: In your experience of the sort of questions. Because obviously it's all multiple-choice is that enough to be meaningful to you?

DOWELANI: It is, because I have choice. And I'm able to evaluate and argue with myself before I answer. And then I'm presented with a palette of choices. It's meaningful because I can immediately gauge the obviously wrong one. Because it's multiple choice, I can really get to pinpoint the right answer by scratching out the ones first. It would be really difficult to do it when you write it down. The multiple-choice gives you the flexibility to assess yourself as well, whether you know the things or not. So the multiple choice questions assess, I think, particularly well if you know what you talking about. It eliminates any guessing.

***Interview with “Dowelani” continued:***

DOWELANI: If there's particularly only one right answer, it becomes valuable to know the work, and for you to pinpoint that answer. So multiple choice questions are really effective and the clickers work naturally with multiple choice questions.

[15:52]

*The interview was suspended due to an interruption lasting about 20 seconds.*

*The recording device was stopped and then started again with a starting time of 00:00*

***Recording – Part 2***

[00:00] INTERVIEWER: The exam then was also multiple-choice. So I suppose what I'm also interested to know is does what you do in the class translate to what helps you outside of the class? Or is clickers just something that helps you in the class?

DOWELANI: Because of the nature of the exam, the multiple choice nature of the exam that we wrote, it's lecturing the same thing. It translates to outside the lecture, sitting in the exams or when you doing your assignment, especially the multiple-choice questions. Because you are basically doing the same that you did in class, this time it is on a computer. You just select the correct answer, so it's basically the same.

[00:50] INTERVIEWER: Did you refer to any of those questions when you did your studies?

DOWELANI: Yes, it's very helpful. It is actually one of the most effective ways of learning, referring back to the question and testing yourself whether you understand the concept or not. So the questions that we did with the clickers in class, give us a very true sense of what we need to know for the exam, and for the assignments that you have need to do in the computer labs. So I would say that they were very helpful.

[01:33] INTERVIEWER: Yes, I'm just sort of trying to understand the “helpful”. Is it helpful because you see the answer, or you have the questions, or you've been through it in class? I'm just trying to understand a little bit more about why is it helpful.

DOWELANI: (pause) Because you have a choice. There's power in choice. Because you can choose, that's how the helpful part comes in, you exercise your power of choice. Because if you are given a palette it is very easy to choose what you want. But in the exam or in a test or in an assignment where you get those choices, you are really going to have to also at the same time assess yourself how well you understand the work. Now that you have choice, and some answers can be very closely related to each other, because you have choice it allows you to challenge yourself to pick the most correct answer. It is helpful in a way that, as well if you didn't study as well, because you have choice you get a chance to not guess but it gives you a chance to look and think back at what you did in class and because the answers might be familiar and you're able to choose the correct answer based on what you listened to in class or wrote in your notes. So the multiple-choice nature of the exam is very helpful as well

[03:23] INTERVIEWER: In your overall experience of the term and your time here at UCT?

DOWELANI: I had the most amazing time. I'd never been to university but my credits at UCT has been very good, been challenging at times, it comes with the territory I guess being at UCT but I enjoyed my first year, first semester at UCT, the hard work, the hours that I've put in. It has been very, very challenging and the I.S. course has helped me specifically with the computer side of things because I have to submit things online for certain courses and I had to print my assignments, and I had to use Excel manipulation to do certain things. So the I.S. course has helped me very much in that respect.

***Interview with “Dowelani” continued:***

[04:20] INTERVIEWER: We do this to help you learn, so has it helped you learn?

DOWELANI: The point came across, because I learnt. It is a course that really achieves its objective in that even the student that has never sat by a computer or never touched a computer can adjust that much easier because of the course. Because everything's technological at UCT. You have to be able to use a computer and the library and the computer labs to access notes on Vula and download assignments and load your workings on your F-drive. I.S. really demystified a lot of computer jargon. For example what is the F-drive, what is the E-Drive, the G-drive that the lecturers download their things from. So the I.S. course has actually achieved its' objective.

[05:25] INTERVIEWER: I suppose the last question for me is about the disadvantages or the negative aspects of clickers in the classroom. Do you think there are any? Or what your experience of them are?

DOWELANI: No they're not. Because of the nature of the clickers they become very impersonal. But I suppose it is up to the lecturer to make it more personal. On their own clickers can become very boring, because they sort eliminate that personal effect that you would otherwise have in the lectures. But the lecturer can fill that gap very easily, so nothing can be 100% good, 100% successful. Some intervention in this case, personal intervention can be very good especially from the lecturer.

[06:26] INTERVIEWER: And I suppose that “personal effect”, will that be maybe asking questions?

DOWELANI: Asking questions, yes, by the lecturer.

[06:36] INTERVIEWER: But then ... your feeling on that?

DOWELANI: No, it's helpful. It keeps the class alert. By so doing the lecturer is also sure that he still has the attention of the class. That he can also assess by talking to the class how everything is going. If they are experiencing any problems as yet.

[07:03] INTERVIEWER: Okay that has been very useful. I suppose is there anything else you want to say?

DOWELANI: (pause) Nothing much.

[07:11] INTERVIEWER: That's all, okay.

*Total Time: 23 Minutes*

**End of interview with “Dowelani”**

## Appendix F – Software Packages Used

### Teaching:

#### Turning Technologies

- *Polling solutions for students*
- <http://www.turningtechnologies.com/studentresponsesystems/studentclickers>
- Support in South Africa by Participate Technologies
- <http://www.participate.co.za>

#### Microsoft Office PowerPoint 2010

- *Presentation and slide software*
- <http://office.microsoft.com/en-us/powerpoint>

### Research:

#### Mendeley Desktop 1.6

- *Reference manager and PDF organiser*
- <http://www.mendeley.com>

### Interview Recording and Transcription:

#### Olympus Digital Wave Player

- *Digital Voice Recorder allowing one to record and transfer to a PC*
- [http://www.olympus-europa.com/consumer/2581\\_vn-3100pc.htm](http://www.olympus-europa.com/consumer/2581_vn-3100pc.htm)

#### F4 v4.2

- *Solutions for digital recording and transcription*
- <http://www.audiotranskription.de/english/f4.htm>

### Data Analysis:

#### ATLAS.ti 6.2

- *Qualitative data analysis and research software*
- <http://www.atlasti.com/index.html>

### Writing:

#### Scrivener for Windows 1.0.3

- *Content-generation tool for writers*
- <http://www.literatureandlatte.com/scrivener.php>

#### Microsoft Office Word 2010

- *Document and word processing software*
- <http://office.microsoft.com/en-us/word>

### Printing:

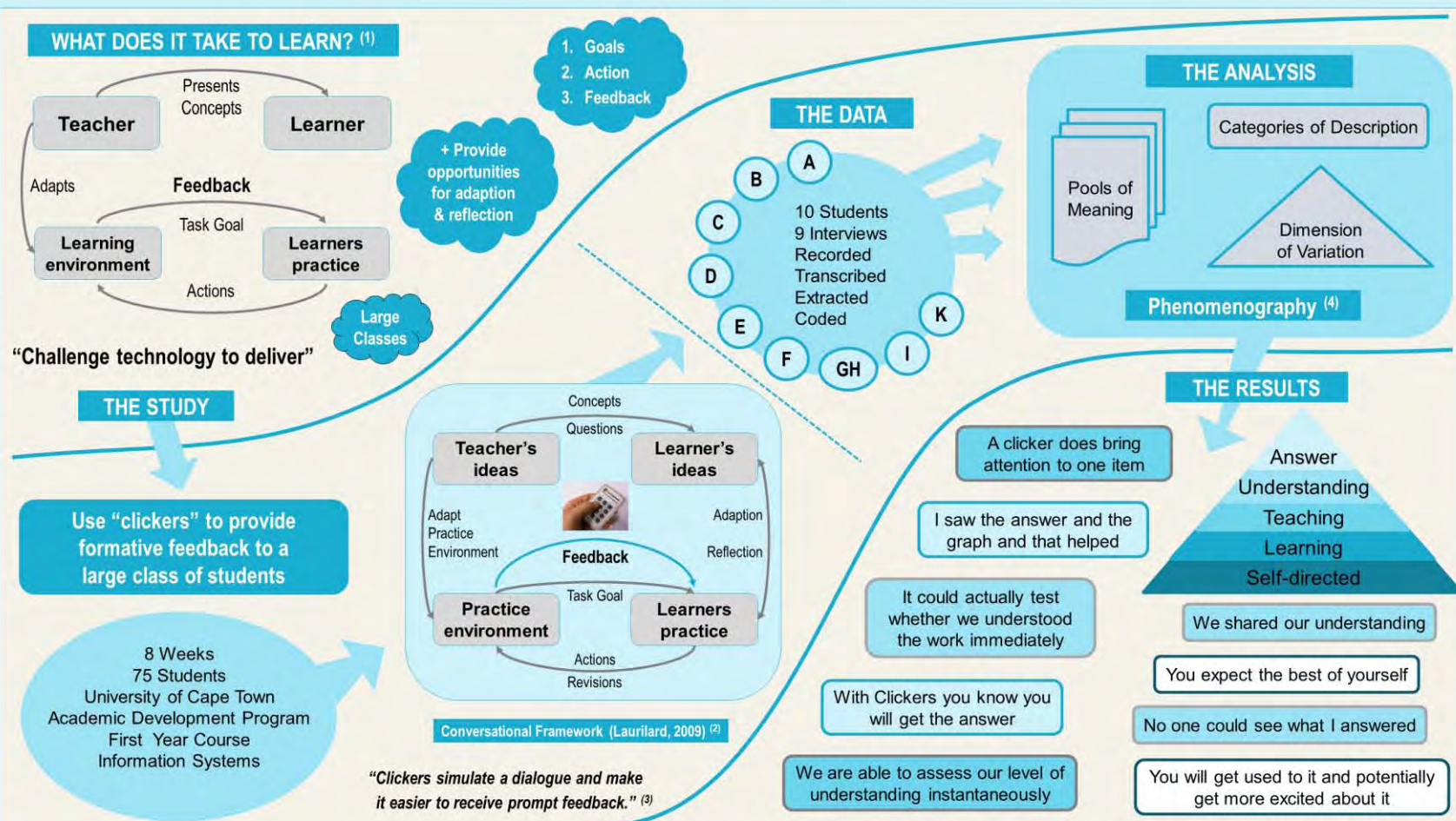
#### FinePrint 7

- *Print the way you want*
- <http://fineprint.com/fp>



# Using a student response system to provide formative feedback in large classes: A phenomenographic study at the University of Cape Town

By Ian Barbour ~ BRBIAN001 ~ MPhil (ICT in Education)



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Supervisor: Associate Professor Cheryl Hodgkinson-Williams ~ Poster presented at UCT on 10 November 2011 ~ Updated 20 February 2012